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# Japan Report

SCIENCE AND TECHNOLOGY

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24 JULY 1986

## JAPAN REPORT

### SCIENCE AND TECHNOLOGY

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## BIOTECHNOLOGY

### MINISTRY'S BIOTECH R&D ACTIVITIES DISCUSSED

Tokyo TOKI NO UGOKI in Japanese 15 Mar 86 pp 22-29

[Ministry of Agriculture, Forestry and Fisheries]

[Text] Prologue

At this time biotechnology is in the spotlight as a technology at the cutting edge, in the same way that microelectronics and the technology of new materials are.

Biotechnology is considered to be the technology that will play a central role in such essential areas as food, energy and medical care. It is expected to open up a bright future for us all.

Over a past number of years, progress has been made in elucidating the nature of biological functions, laying down the foundation for the bounding development of biotechnology. One such example is the discovery that DNA is common to all genes.

Technologies precursory to today's biotechnology have long been available to such industries as agriculture, forestry, fisheries and food. Examples include methods for improving breeds of plant and livestock and the utilization of microorganisms in the production of sake, soy sauce, bread and cheese. In the future, application of biotechnology to these areas, will make it possible to respond to demands for increasing the varieties of agricultural products, to lower production costs, or to achieve drastically increased efficiency in the production of food and other items.

The following is a simplified introduction to the methods of biotechnology and an account of the ways in which the Ministry of Agriculture, Forestry and Fisheries (MAFF) is grappling with the task of research and development (R&D) in biotechnology.

#### I. What is Biotechnology?

Biotechnology is characterized as a "technology that actively makes use of [biological] production per se or exploits its functions most efficiently." Therefore technologies in the area of agriculture, livestock, forest trees and

fish and shellfish that produce crops, or technologies in the food industry that make use of microorganisms may themselves be called biotechnology. Usually, however, the term biotechnology is used largely to refer to three techniques: 1) genetic manipulation, 2) cell culture and 3) utilization of microorganisms/enzymes (Figure 1), limiting the area of operation to the microscopic world of cells and genes.

The individual techniques named above will be explained simply.

#### 1) Genetic recombination

A technique of creating new organisms that possess new combinations of genes (new characteristics) by inserting useful genes (DNA) from certain organisms into other organisms.

#### 2) Cell fusion

Protoplasts (naked cells) are produced by removing the cell walls of individual cells; with plant cells, cellulase (cellulose dissolving enzyme) is used. This is the technique of creating a new cell by fusing the protoplasts of different kinds of cells.

#### 3) Nucleus transplantation

A technique of removing the cell nucleus and replacing it with another nucleus from a fertilized egg.

By combining with the technique of fertilized egg transplantation, it becomes possible to reproduce simultaneously many excellent strains of livestock.

The technique of fertilized egg transplantation, basic to the present technique, is applied so as to have ordinary female livestock produce offspring of an excellent strain, or to produce twins of a beef breed via a dairy cow. Research to further establish the technique is in progress, for the technique can also be applied to other purposes, for example, to the determination of animal sex (male or female) at will.

#### 4) Chromosomal Manipulation

A technique to hatch all female fish or to make all fish infertile (grow faster) by manipulating fish sperm or eggs at the time of fertilization. It can be applied to species other than fish.

#### 5) Cell culture

A technique to culture plant or animal cells in artificial culture media.

The technique is used to proliferate cells that have been separated and selected from organisms or cells that have undergone genetic recombination or cell fusion. The technique is also utilized to have these cells make useful products.

## 6) Tissue culture

A technique to grow a whole plant from a plant tissue cultured in an artificial medium.

One example of the technique is the production of virus-free crops via meristem tip culture, for viruses do not invade growing points. Examples of virus-free products are strawberry, garlic and carnation.

The technique is also applied to reproduce the same plant in great quantities (orchids and lillies) and to improve a breed by inducing mutations (see Figure 2).

## 7. Anther culture

A technique of reproducing a whole organism by culturing anther (a sack at the tip of the stamen that contains the pollen.)

Haploids (plants with half the normal number of chromosomes) can be produced via the anther culture technique from the pollen or pollen mother cells. When the number of chromosomes is doubled after treatment with chemicals (e.g., colchicine), these plants obtain the normal number of chromosomes and stabilized characters.

With autogamous plants, it takes several generations after hybridization to reach the final form of the specie. The time required to achieve this will be greatly reduced by the technique of anther culture.

A typical example of the technique is shortening the development of rice breeds and production of a high yield type of strawberry (see Figure 3).

## 8. Embryonic culture

A technique of reproducing organisms through culture of embryos (fertilized eggs of multicell organisms at an early stage of growth).

Hybridized cells obtained by crossing different kinds of plants often stop growing after fertilization with the result that no seeds are formed. When young embryos are taken at an early stage of growth and cultured in test tubes, however, growth occasionally continues and, as a result, hybrids may be obtained.

"Hakuran," the cross between Chinese cabbage (hakusai) and cabbage (kanran), was produced by the MAFF using this technique (Figure 4).

## 9. Bioreactors

Enzymes are produced inside organisms and function as catalysts by facilitating reactions of synthesis and decomposition at normal temperatures and under normal pressure. In addition, they possess the singularity of action on a specific substance in a mixture.

Bioreactors constitute a technology to maintain chemical reactions by utilizing enzymes as catalysts in synthesis or decomposition of substances. Enzymes, or microorganisms that possess enzymes within themselves, are first fixated for the purpose.

## II. Areas Where Biotechnology Can Be Applied

The techniques described above can be applied to various areas. The following items are such examples:

### A. Agriculture

- 1) Creation of crops with epoch-making new characteristics (e.g., stable and high productivity, resistance to diseases and pests, nutritiousness, low fertilizer requirement and excellent flavor): improvement and stabilization of crops over a short duration.
- 2) Large-scale production (e.g., clone plant production) of excellent and healthy seeds and seedlings.
- 3) Control of disease and pests through production of "low pathogenic viruses" that act similarly to vaccines, and of microorganisms that function as natural predators.

### B. Livestock

- 1) Livestock breeding
- 2) Large-scale production of excellent and wholesome livestock and determination of sex via transplants of fertilized eggs.
- 3) Highly precise diagnosis of livestock diseases and production of remedial drugs utilizing monoclonal antibodies (pure antibodies, the production of which is made possible through the technique of cell fusion).
- 4) Large-scale production of growth hormones and vaccines for livestock.
- 5) Production of feed from unutilized resources.

### C. Forestry

- 1) Breeding of forest trees and mushrooms and large-scale production of seeds and seedlings.
- 2) Biomass utilization of unused forestry products.
- 3) Utilization of phytoncides.

### D. Fisheries

- 1) Breeding of fish, shellfish and seaweed.



- 2) Determination of sex and the production of infertile fish.
- 3) Production of vaccines and growth hormones for fish.
- 4) Large-scale production and breeding of fish feed/chlorella.
- 5) Biomass utilization of seaweed.

#### E. Food industry

- 1) Improved efficiency in the production of amino acids and sugars via improvement and fixating microorganisms.
- 2) Production of trace components (coloring/flavor) for food.
- 3) Management of food production processes and quality using biosensors.
- 4) Waste water treatment

### III. State of Biotechnology Promotion at the MAFF

MAFF considers biotechnology as the key technology in the areas mentioned above and is promoting relevant research and development as a project of the entire ministry.

In particular, in 1983 an Institute of Agricultural and Biological Resources was established as one of the national research institutes to act as the hub of biotechnology research. In 1984, a system for development and promotion was completed with the opening of the Biotechnology Office, a center for policy matters, as well as with the formation of a "Council to Propel Development of Advanced Biotechnology," a mechanism to consult the opinions of scholars and persons experienced in the field related to problems to be expected in the course of promotion.

Work to improve gene banks, the basis for biotechnology R&D, has been under way in earnest since FY 1985.

The budget for R&D has doubled in FY84 as compared to the previous year, with a 50 percent increase in FY85 and a 30 percent increase being proposed for the FY86 budget plan, while the budget for the MAFF as a whole is declining.

For the efficient utilization of budgeted funds, the cooperation of industry, academia and governments is to be strengthened to carry out the R&D in such a way that each of its segments may function optimally.

The outline of the R&D in the FY86 budget plan is as follows: In FY86, a systematic and general breeding project via biotechnology will be pressed forward with a view toward the 21st century; at the same time, a project for technological innovation in the food industry will be promoted, utilizing private sector vitality. (Table 1)

# 1. Promotion of Breeding via Biotechnology With a View Toward the 21st Century

"Integrated research on plant breeding via biotechnology" is to begin in FY 86. Advances in biotechnology, as evidenced in cell fusion and recombinant DNA, have established basic technologies of gene utilization, impossible with traditional methods of breeding. On the strength of prospects for breeding epoch-making species and the creation of new useful plants, the MAFF will set in motion an integrated R&D project set on concrete breeding targets, making use of advanced technologies of cell fusion or recombinant DNA, with a view toward the 21th century.

To further strengthen and enhance the R&D system in biotechnology, assistance and guidance will be given to "regional biotechnology R&D," cooperative research efforts between local governments and universities, centered on high potential results being obtained from government sponsored basic research.

Together with the development and management of basic technologies for breeding, efforts will be made to enrich and strengthen the collection of gene resources and information, assets dispensable to breeding and biotechnology R&D.

These efforts entail the expansion of the general utilization system (agricultural, forestry and fisheries gene banks) that covers the entire areas of agriculture, forestry and fisheries, in particular, plants, microorganisms, animals, marine biota and forest trees. Collection and management of gene resources and information on genetic breeding will thus be upgraded and strengthened and, concurrently, the storage of these resources will be studied (see Table 2.)

On the educational front, efforts will be made to train Japanese researchers. Cooperative research with researchers from three nations, two European and the United states, that are at the top level of biotechnological research in the world, will be promoted, to facilitate the training of Japanese researchers.

## 2. Promotion of Technology Innovation Project in the Food and Other Related Industries

For technological innovation in the food industry, as well as in other related industries such as the agricultural chemicals and fertilizer industries, advanced biotechnological techniques will be actively developed in the areas in question through utilization of private sector vitality, under the umbrella of an organic coalition between industry, academia and government. The government itself will carry out research in developing techniques to control root environment.

## 3. Establishment of an Organization for the Promotion of Technological Research in Specific Biological Industries (temporary name)

A planned "Organization for the Promotion of Technological Research in Specific Biological Industries" (temorary name) aims at private sector

technological research centered about biotechnology. It is budgeted at Y3.8 billion as investment and loans from the Special Account for Industrial Investment.

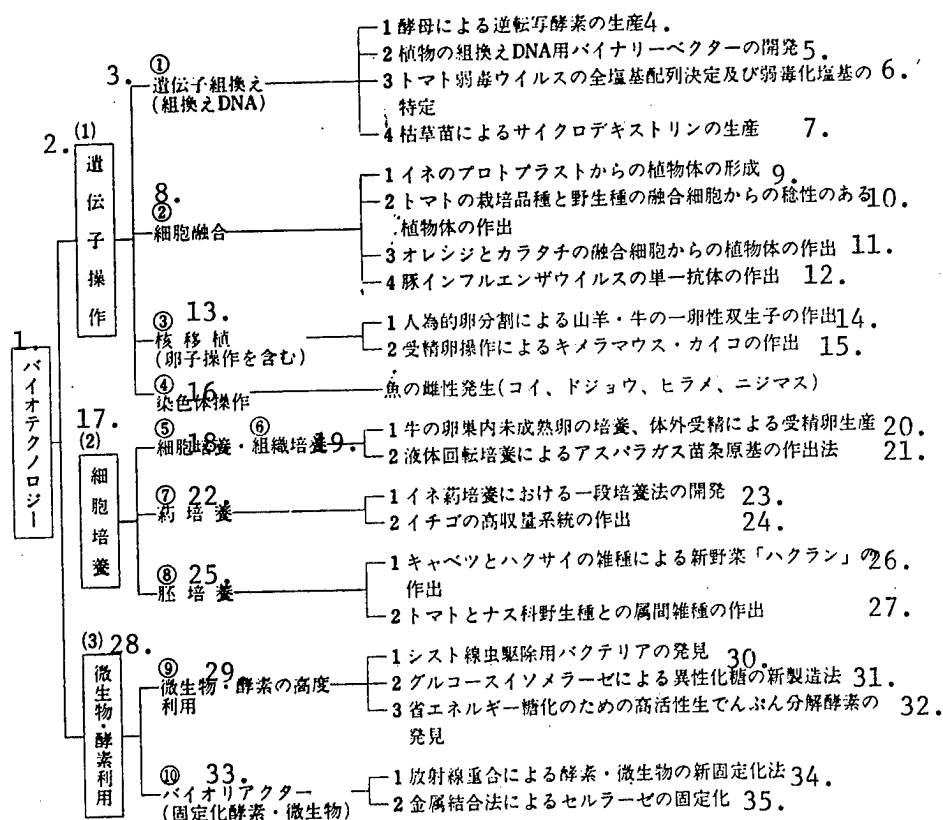
## Epilogue

As may be seen above, the biotechnology that the MAFF concerns itself is very wide and deep in scope, covering wide areas of R&D applications for which the concerted efforts of industry, academia and the government are necessary. MAFF's contributions include grants and contracts to the private sector and universities, cooperative research with the private sector, training of researchers from the private sector at national research institutes, training provided through the Agricultural, Forestry and Fisheries Technical Information Association (public interest corporation) and duplication services for research literature.

"Plants created from fused cells of orange and trifoliate orange" listed among research results in Figure 1, resulted from cooperative research by the MAFF and Kikkoman Shoyu Co., Ltd. "Plants created from fused cells of cultivated and wild tomato" resulted from a contract given to Nihon Tobacco Industry, Inc., a part of MAFF's research project. Both are considered to the world to be accomplishments at the cutting edge of the field. It appears that the fruits of cooperative efforts are gradually being harvested.

Included among the tripod of industry, academia and the government are the research organizations of local governments, powerful instruments in raising research results to practical levels. To facilitate their function, it is necessary to provide wide gene resources and information, as well as to promote the exchange of information.

Figure 1

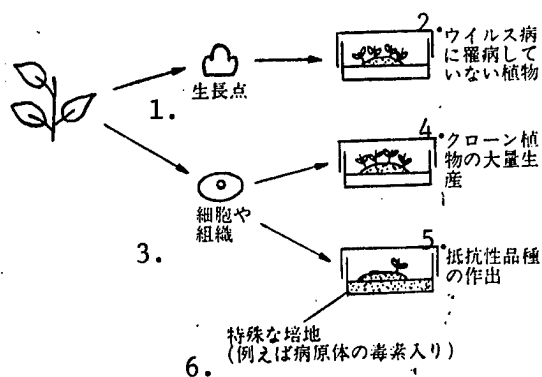


[Key on following page]

Key:

- (1) Biotechnology
- (2) Gene manipulation
- (3) Gene recombination (recombinant DNA)
- (4) Production of reverse transcriptase via enzyme
- (5) Development of binary vector for plant recombinant DNA
- (6) Determination of the entire base sequence of low pathogenic tomato virus and specifying the base that causes low pathogenic action
- (7) Production of cyclodextrine via bacillus subtilis [\* see note attached]
- (8) Cell fusion
- (9) 1 Formation of plants from rice protoplast
- (10) 2 Production of fertile plants from fused cells of cultivated and wild tomato
- (11) 3 Creation of plants from fused cells of orange and trifoliate orange
- (12) 4 Creation of a monoclonal antibody for swine influenza virus
- (13) Nuclear transplantation (including egg manipulation)
- (14) 1 Creation of identical twins of goat and cattle by artificial splitting of eggs
- (15) 2 Creation of chimeric mouse/silkworm by manipulation of fertilized eggs
- (16) Chromosome manipulation  
Creation of female fish only (carp, loach, flounder and rainbow trout)
- (17) Cell culture
- (18) Cell culture
- (19) tissue culture
- (20) 1 Culture of immature eggs found in cow's ovary; production of fertilized eggs via in vitro fertilization
- (21) 2 Creation of asparagus shoot primordia through liquid rotatation culture
- (22) Anther culture
- (23) 1 Development of a one-step culture method for rice anther culture
- (24) 2 Creation of a high yield strawberry strain
- (25) Embryo culture
- (26) 1 Creation of "hakuran," a new vegetable through hybridization of cabbage [kanran] and Chinese cabbage [hakusai]
- (27) 2 Creation of hybrids through intra-species cross breeding of tomato and wild species of solanaceae
- (28) Utilization of microorganisms and enzymes
- (29) Sophisticated use of microorganisms and enzymes
- (30) 1 Discovery of bacteria that expels cyst namatodes
- (31) 2 New production method of isomerized sugar using glucose isomerase
- (32) 3 Discovery of a highly active raw starch dissolving enzyme used for energy saving saccharification
- (33) Bioreactor (fixation of enzymes and microorganisms)
- (34) 1 New method of fixating enzymes and microorganisms through radiation induced polymerization
- (35) 2 Fixation of cellulase through metallic bond

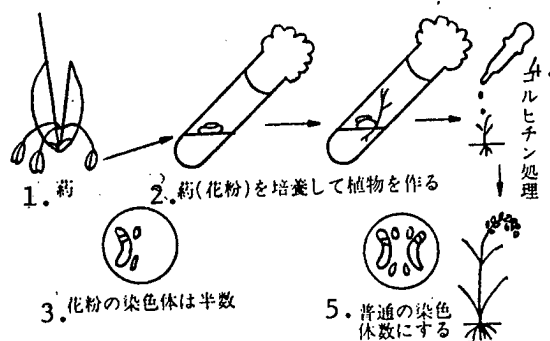
Figure 2 Application of tissue culture



Key

1. Growing point
2. Plant free from virus disease
3. Cells/tissues
4. Large scale production of clone plant
5. Creation of species resistant to specific diseases
6. Special culture media (e.g. culture medium that contains toxins of certain pathogenes)

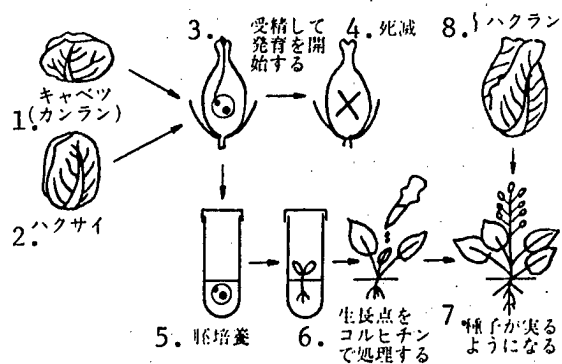
Figure 3 Example of plant creation via anther culture



Key

1. Anther
2. Creation of a plant via anther (pollen) culture
3. Number of pollen chromosome is one-half of normal plant
4. Treatment with colchicine
5. Normal number of chromosomes obtained

Figure 4 Creation of hakuran via embryo culture



Key

1. Cabbage [kanran]
2. Chinese cabbage [hakusai]
3. Initiation of growth after fertilization
4. Failed growth
5. Embryo culture
6. Treatment of growing point with colchicine
7. Seed bearing plants obtained
8. Hakuran

Table 1 Budgeted biotechnology related items  
MAFF (unit: Y1 million)

1. 項	目	2.	60年度予算額	61年度予算額
4.	1. 21世紀を見通したバイオ育種の推進 (バイオ育種2000年)		(1,551)	(2,032)
5.	(1)バイオ植物育種に関する総合研究の推進(新規) (注) 一部は従来のプロジェクトの組換え		(317)	(445)
6.	(2)地域バイオテクノロジー研究開発の促進(新規)		( 0)	(234)
7.	(3)基盤技術の開発等		(386)	(420)
	・バイオテクノロジー先端技術シーズ培養研究		100	100
	・農業生物における遺伝子発現機構の解明		40	44
	・農業生物における遺伝子の構造解析(新規)*		0	34
	・細胞融合・核移植による新生物資源の開発		115	112
	・細胞融合による微生物・植物細胞の改良技術の開発*		48	45
	・組織培養による種苗の効率的生産技術の開発*		55	57
	・魚介類の雌性発生等による育種技術の開発		28	27
8.	(4)遺伝資源・情報の収集、管理の充実強化		(836)	(915)
	ー農林水産遺伝資源の整備等ー			
	・農林水産生物遺伝資源・遺伝育種情報の総合的管理利用システムの整備		390	436
	・農林水産生物遺伝資源管理施設の整備		338	363
	・動物遺伝資源の長期保存法に関する研究(新規)等		107	117
9.	(5)人材の養成・国際研究協力等		( 13)	( 18)
10.	2. 食品産業等に係る技術革新プロジェクトの推進		(409)	(548)
	・食品産業におけるバイオリアクターシステムの開発*		244	259
	・新農薬開発のための細胞培養等共通基盤技術の開発*		66	62
	・免疫利用による家畜疾病の簡易診断法の開発*		45	43
	・新肥料開発のための生物活性利用等基盤技術の開発(新規)*		0	26
	・バイオマス変換への微生物・酵素の新利用技術の開発		55	63
	・根圏環境の動態解明と制御技術の開発(新規)		0	95
11.	※生物系特定産業技術研究推進機構(仮称)の設立			
	12. 合 計		1,960	2,579

13. (注) \*は民間による研究開発である。

[key on following page]

Key

1. Items
2. Budgeted amount in FY 85
3. Budgeted amount in FY 86
4. 1. Promotion of breeds through biotechnology with a view toward the 21st century (Biotech Breeds 2000)
5. (1) Promotion of integrated research on plan breeds through biotechnology (new)  
(note) Partly, reorganization of existing projects
6. (2) Facilitating regional biotechnology R&D (new)
7. (3) Development of basic technologies  
Research on cultured seeds, a biotechnology at the cutting edge  
Elucidation of the mechanism of gene manifestation in agronomic biology  
Analysis of gene structure in agronomic biology (new)\*  
Development of new biological resources through cell fusion and nucleus transplantation  
Development of technologies to improve microorganisms and plant cells through cell fusion\*  
Development of efficient production technology of seeds and seedlings through tissue culture\*  
Development of breeding technology through the artificial determination of sex (e.g. females only) in fish and shellfish
8. (4) Enhancement and strengthening of the collection of gene resources and information, and its management  
--Improvement of the MAFF gene bank, etc.--  
Improvement of the general management and utilization system of MAFF gene resources/genetic breeding information  
Improvement of facilities for the management of agricultural, forestry and fisheries gene resources  
Research on the long-term storage of animal gene resources (new)
9. (5) Personnel training/international research cooperation
10. 2. Promotion of project on technological innovation in the food industry and other related industries  
Development of bioreactor systems in the food industry\*  
Development of common basic technologies, such as cell culture, for the development of new agricultural drugs\*  
Development of simple immuno-diagnostic methods of livestock diseases\*  
Development of basic technology for the utilization of biological biological vitality, leading toward the development of new fertilizers (new)\*  
Development of new technologies to utilize microorganisms and enzymes, leading toward biomass conversion  
Elucidation of dynamics of root environment and the development of its control technology (new)
11. Establishment of the Organization for the Promotion of Technological Research in Specific Biological Industries (temporary name)
12. Total
13. (Note) \* indicate R&D in the private sector



Table 2 Plan for the collection and preservation of agricultural, forestry and fisheries gene resources (target at the end of FY 92)

	Plants	Microorganisms	Animals	Marine biota
Present	100,000 items	(5,000 items)	(560 items)	(150 items)
Target	230,000	13,000 items	fertilized eggs (cattle, horse) & other organisms (pig, goat, sheep, chicken and hare)	2,1000 algae and individual marine biota

(Note)

Small figures in ( ) indicate items collected for research up to the present.

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## CHEMICAL ENGINEERING

### TORAY'S ADVANCE INTO NEW TECHNOLOGIES DISCUSSED

Tokyo TSUSAN JANARU in Japanese Mar 86 pp 72-74

[Article by Kaoru Maki]

[Text] A new age of chemistry is about to begin. The advances made in scientific technology have to a remarkable degree succeeded in "dissecting" even down to the compositional units of material substances and have been elevating the discipline of chemistry by leaps and bounds. The results of these advances will find their applications within the chemical industry, where epoch-making products, breaking conventional modes of thinking, will be created. It is indeed the arrival of a "new chemical age," and among Japanese firms, Toray is the one that will shoulder the responsibilities of this new age. Established in 1926, Toray, as Japan's No 1 synthetic textile manufacturer, can be said to be the enterprise that is most determined to transform itself as it prepares for the new age.

#### The New "Technology Center" Is Toray's Strategic Base

The Toray facilities in Shiga, where it all began for Toray, are about to be transformed significantly. The facilities, located in the Sonoyama section of Otsu City near Lake Biwa, constitute a landmark in the history of textile manufacturing in Japan. With the opening of new nylon manufacturing facilities at Ishikawa Plant in Ishikawa Prefecture, Toray will cease textile production in Shiga by the end of June. In its place, the nucleus of the Shiga plant will be a "technology center," a brain-trust of sort for Toray as it strives to become a comprehensive chemical manufacturer. Accommodating about 2,000 researchers and technicians who will staff the 3 divisions of production, R&D, and engineering, the center will be organized as a strategic base that will enable Toray to realize its potentials to the fullest.

The center has been operating since last April, but recently 100 new employees, including top officials of the three divisions, joined the 1,200 researchers and engineers already in place, bringing the total work force in Shiga to 1,300.

Toray's primary aim in establishing a technology center is to abridge the time between R&D and production. In the coming age, that will be marked by rapid technological innovations, product life-cycle will also be shortened. Unless a manufacturer can strive to close the time-gap between

R&D and production as much as possible, it cannot hope to survive in the competition for product development. Toray's goal in establishing the center is to create a system which would lead swiftly to final production. Another goal is to provide for a more functional use of its personnel, even overstepping the organizational bounds.

For example, let us suppose an idea is born concerning the development of a new product that uses high performance ceramics, whose properties have shown to be far superior to those found in conventional ceramics. At Toray, this idea would be transmitted immediately to the technology center, where its productibility would be examined. Since the center is always staffed with specialists in the three areas of R&D, engineering, and production technology, an intense discussion would take place among the experts. If necessary, engineers will be called upon from other plants and business offices throughout the country. By the time a "go ahead" sign is given, decisions would have been made on target goals and time schedules for R&D and production technology, and plants would have been selected and personnel relocated. The center would thus provide for an extremely speedy processing of ideas into products.

The main hub of the center is a three-story structure located within the Shiga plant site that opened last April. On the first floor of the building is a showroom that demonstrates to all Toray's wide range of technological capabilities and, on the third floor, a large room is shared by three men who head the three divisions mentioned above. The company plans to construct a building housing an information center within the plant site. It also plans to set up a communications network system that would enable the center to hold TV conferences with its headquarters in Tokyo and Osaka, and facilitate communication with other plants throughout Japan.

#### President Ito's Strong Personality: He Leads the Employees

In the background to Toray's glorious transformation was the strongly influential personality of its president Yoshikazu Ito. He was born in 1925 in Kobe, majored in agricultural chemistry in the Department of Agriculture at Kyoto University, and entered Toyo Rayon (present Toray) in 1948. He is an engineer who, beginning in his 3d year with the company and for the next 13 years, worked on and eventually invented a method called PNS (photonitrosation method), which is said to represent an epochal development in the manufacture of raw materials for nylon. The technology based on this method simplified the manufacturing process of raw materials for nylon and greatly reduced the manufacturing cost; it won just about every academic honor in the field. It is said that for some time after his method had been put into actual use, his income from royalties exceeded his annual pay.

Ito, with these past achievements, became president in January 1981. The first task that this born engineer tackled after assuming presidency was to revolutionize the company's marketing practice. Toray was first established by Mitsui & Co., Ltd. as a rayon manufacturing company, so that in the beginning it lacked a sales division and its image historically was that

of a "technological leader." However, since he became president, Ito, who had been principally a career engineer, and had once headed the R&D center at Toray, preached stubbornly about the "need for marketing."

"Marketing represents the front wheels of a front-wheel drive car, and R&D the rear wheels" was what he would say. He would also say that, "technology is simply a means for marketing." The employees, who had been accustomed to hearing that "Toray is Technology" and were proud of such a reputation, were surprised. Their reaction was natural, for Ito's statements were designed to send a message that "leadership in marketing" was now what Toray needed. In October 1983, a marketing division was established in the main office and Toray embarked upon marketing strategies that cut across the entire organization. Ito, the engineer-president had had the sufficient vision to predict that a time would come when "just making things will not necessarily lead to things being sold."

Ito is not the type of person who would shut himself up in his office and rack his brains. Beginning in January 1984, he began a "consciousness-raising" revolution designed to revitalize his employees. He himself led the charge in initiating CI (corporate identity) activities aimed at creating a new image for Toray. He toured 13 business offices and plants, shaking hands and drinking with plant workers, and discussing the future of Toray with them. He has already completed two rounds of "factory visits," and becomes deeply emotional when he says, "I felt with my own body how important kinship is." The consciousness-raising revolution, which is designed to instill confidence and restore vitality in the 13,000 member work force, is seeing results.

#### Toray Will Be Reborn in April

Toray is creating a succession of new businesses and coming out with new products. For example, there is the carbon textile known by its brand name of (Toreka). Marketed since 1981, it has already found a niche as a material for various sporting goods, such as tennis rackets, golf clubs and fishing rods, and its application is expected to grow in the future. Many people are surprised to learn that the aerospace industry uses (Toreka) as a structural material for parts of aircraft wings and main body as well as for the stationary weather observation satellite "Himawari (Sunflower)."

In addition, there is the "Magic Membrane," which separates seawater into fresh water and salt, a technology that Toray is proud of. It is a thin membrane (highly functional high polymer film) which came about as a result of high polymer chemical and textile technological know-how that Toray had accumulated over more than half a century. In converting seawater to fresh water using this membrane, only one-fourth of the energy required in conventional evaporation method is all that is needed. The interest for this product is strong in the Middle East. In addition, the membrane plays an important role in providing ultra pure water which is indispensable in manufacturing semiconductors. This is because the membrane removes all dust particles and virus from the water as it passes through it.

Toray has been demonstrating its technological potentials in other, far-reaching areas. For example, there are Japan's first contact lenses that adjust so remarkably well to body physiology that a wearer need not remove them before going to sleep, and the anti-cancer drug, interferon, whose factory production Toray began for the first time in the world.

The introduction of these new businesses and products is reflected in Toray's sales. The figures for March 1985 show total sales of Y626.9 billion, of which textiles comprise 65 percent and non-textiles 35 percent. While these figures show that textiles still occupy a bigger share than non-textiles, the position is completely reversed--35 percent for textiles, 65 percent for non-textiles--when sales are calculated on the basis of ordinary profits. Toray has a long term plan to raise, by FY 1995, its total sales to Y1.3 trillion and its percentage of ordinary profits to sales to about 7 percent. These goals are based upon a premise that the ratio of textile and non-textile sales to total sales should be at 35:65. For this reason, new businesses must be created at an even greater intensity than in the present, and it can be said that a passion to transform Toray is already evident in its active, forward-looking investments, such as the Y50 billion annually allocated for equipment and Y20 billion for R&D.

On this year's Founder's Day which will take place on 16 April, Toray will announce a new CI policy. It will contain new corporate ideas, management policies, and guidance for company activities. It is expected that the day will be filled with events that will deny the place of old Toray and impress upon the minds of participants the image of a new Toray. When this campaign, called a "New Foundation Movement," begins, Toray's corporate transformation strategy will finally have reached its peak.

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CSO: 4306/3053

DEFENSE INDUSTRY

AIRCRAFT PROCUREMENT LIST FOR FY85 REPORTED

Tokyo AEROSPACE JAPAN in Japanese May 86 p 27

[Text] Fiscal year 1985 aircraft procurement list.

During the fiscal year which ended in March, the Defense Agency's Central Procurement Office made 9,373 contracts for ¥1.1525 trillion of which contracts for airplanes and their engines are as follows in the chart below.

[Ground Self-Defense Force]	Quantity	Contracting Company	Sum	Term
AH-1S anti-tank helicopter	8	Fuji Heavy Industries, Ltd.	9,544,000,000	63. 3.25
T53-K703 engine	8	Kawasaki Heavy Industries, Ltd.	1,160,800,000	62.11.30
OH-6D observation helicopter	7	Kawasaki Heavy Industries, Ltd.	1,081,000,000	62. 3.18
250 C20B engine	7	Shintoa Koeki Kaisha, Ltd.	196,750,000	61. 9.30
HU-1H multi-use helicopter	5	Fuji Heavy Industries, Ltd.	2,081,000,000	62. 3.10
T53-K13B engine	5	Kawasaki Heavy Industries, Ltd.	565,000,000	61.11.29
CH-47 transport helicopter	3	Kawasaki Heavy Industries, Ltd.	9,544,000,000	63. 3.25
T55-K712 engine	6	Kawasaki Heavy Industries, Ltd.	1,957,800,000	62. 8.31

[Maritime Self-Defense Force]	Quantity	Contracting Company	Sum	Term
P-3C anti-submarine patrol plane	10	Kawasaki Heavy Industries, Ltd.	42,878,730,000	64. 3.25
T-56-14 engine	40	Ishikawajima-Harima Heavy Industries, Ltd.	10,253,200,000	63. 8.31
U-36A drill support plane	1	Toyo Menka Kaisha, Ltd.	1,212,000,000	61.12.15
U-36A drill support plane remodelled version	1	Shin Meiwa Industry Co. Ltd.	373,519,000	63. 3.30
HSS-2B anti-submarine helicopter	10	Mitsubishi Heavy Industries, Ltd.	13,391,000,000	63. 3.31
S-61A rescue helicopter	1	Mitsubishi Heavy Industries, Ltd.	1,337,100,000	62.10.30
[Air Self-Defence Force]				
F-15 Combat plane	14	Mitsubishi Heavy Industries, Ltd.	65,992,800,000	64. 3.31
F100-IhI-100 engine	26	Ishikawajima-Harima Heavy Industries Co. Ltd.	29,217,468,000	63. 8.31
C-130H transport plane	2	United State's Air Force	11,814,952,000	63. 3.25
T-2 advanced practice plane	4	Mitsubishi Heavy Industries, Ltd.	5,276,000,000	63. 3.31
TF40-IHI-801 engine	8	Ishikawajima-Harima Heavy Industries Co. Ltd.	2,760,000,000	63.10.25
MU-2 search and rescue plane	2	Mitsubishi Heavy Industries, Ltd.	892,000,000	62. 1.28
CH-47 transport helicopter	1	Kawasaki Heavy Industries, Ltd.	3,331,000,000	62.12.25
T55-K712 engine	2	Kawasaki Heavy Industries, Ltd.	657,000,000	62. 6.30
V-107A rescue helicopter	5	Kawasaki Heavy Industries, Ltd.	4,490,000,000	62. 3.14

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DEFENSE INDUSTRY

BRIEFS

NEW F-15 FLIGHT SQUAD ESTABLISHED--On 19 March the Air Self-Defense Force formed flight squad 201 of the 2d Air Wing with 18, F-15J's and about 100 men at the Chitose base in Hokkaido. Flight squad 201 is the fourth F-15 flight squad, and together with flight squad 203 puts the 2d Air Wing in possession of 2 F-15 flight squads. Also, on the same day at the Naha base in Okinawa F-104 flight squad 207 was reorganized. On 26 November this 5-104 flight squad was transferred from Chitose base as flight squad 302 to the Naha base, and as of 16 December began anti-invasion duty of territorial air space, whereby it gave up its seats to flight squad 302. With this the last of the F-104 flight squads have gone. [Text] [Tokyo AEROSPACE JAPAN in Japanese May 86 p 27] 13153/9835

FIRST TARGET DRONE FLIGHT --On 12 and 13 March the Air Self-Defense Force held the first Japanese target drone programmed flight. This was for technology testing. Two planes will be delivered, one each in April and May, so that in May flight tests can be held completing technology testing. During the first test held in March an F-4 was loaded, but the second test, an F-15 is to be loaded. Subsequent to the technology testing there will be practical use testing with five planes to be delivered between July and September. This will be completed in December. The approval of the director general of the Defense Agency for its employment by (military) units is being sought. [Text] [Tokyo AEROSPACE JAPAN in Japanese May 86 p 27] 13153/9835

NEW ANTISUBMARINE HELICOPTER SYSTEM--A new anti-submarine helicopter system which is still in trial manufacture, has received a second order. On 19 March the Defense Agency's Central Procurement Office ordered a model 1 anti-submarine helicopter carrier-base systems (section 2) as requested by the Technical Research and Development Institute, for ¥7,003,735,000 from Mitsubishi Heavy Industries, Ltd. Delivery is set for 31 July 1987. In 4 years about ¥30 billion has been appropriated for the trial manufacture of this anti-submarine helicopter and its prototype the SH-60. This order was placed in the 3d year and includes automatic flight control devices, the loading of two such devices on each of two helicopter combat system models, and the remodeling of the number 2, SH-60 helicopter. [Text] [Tokyo AEROSPACE JAPAN in Japanese May 86 p 27] 13153/9835



FIRST ANTITANK HELICOPTER SQUAD ESTABLISHED--On 25 March the Ground Self-Defense Force established its first anti-tank helicopter squad at Obihiro base in Hokkaido. Because this anti-tank helicopter squad can cross long distances and wide areas and reacts swiftly, it was organized as the first northern air squadron. It was started with 8, AH-1S anti-tank helicopters, 2, OH-6 reconnaissance helicopters, and about 140 men, but by the end of fiscal year 1986 plans are to achieve full capacity with 16, AH-1S's (two flight groups), 4, OH-6's, and 200 men. As the first Ground Self-Defense Force combat unit, it contributes, along with various other units, to 3-dimensional combat capabilities, and has become part of combat leadership. On the same day it was also announced that Colonel Shirokawa was to be the first commanding officer. [Text] [Tokyo AEROSPACE JAPAN in Japanese May 86 p 27] 13153/9835

XF 3 TEST COMPLETED--On 7 March the Defense Agency's Technical Research and Development Institute completed 1 and 1/2 years of oscillation stress testing of the XF 3 with qualifying tests (QT) which began July 1984 at the Tachikawa No 3 research center. With the completion of the ordering and evaluation of test results, formal confirmation was received around the end of May that this F-3 engine can be loaded on to X7-4 medium practice planes. [Text] [Tokyo AEROSPACE JAPAN in Japanese May 86 p 28] 13153/9835

FUTURE COMBAT PLANE RELATED RESEARCH--The Defense Agency's Central Procurement Office ordered the trial manufacture of computers to be loaded on combat planes (section 2) as requested by the Technical Research and Development Institute from Mitsubishi Electric Co. Ltd. for ¥2,538,515,000. This is one form of future combat plane research. Since March further contracting of this kind includes: 1) a new FLIR [Forward-Looking Infrared Radar] system test device from Fujitsu, Ltd. for ¥1,689,835,000; 3) a future ASM [Air to Surface Missile] use infrared rays picture guidance system from Mitsubishi Heavy Industries, Ltd. for ¥650,761,000; 4) an active radar homing device from Mitsubishi Electric Co., Ltd. for ¥623,493,000 and 5) an XGCS-1 bomb guidance system from Mitsubishi Electric Co., Ltd. for ¥3,025,777,000. [Text] [Tokyo AEROSPACE JAPAN in Japanese May 86 p 28] 13153/9835

CSO: 4306/2076

## ENERGY

### ALTERNATIVE ENERGY SOURCES DISCUSSED

Tokyo FINANCE in Japanese Mar 86 pp 42-50

[Article by Hirofumi Gomi, assistant accounting officer, Budget Bureau, in "Special Budget Issue No 2"]

[Text] 1. Background

(1) Reflecting the development and introduction of oil-substitute energy and the energy-saving drive, global demand for oil has gradually declined since 1980 (in 1984, it rose 2 percent from the previous year).

Amid the decline of oil demand in the free world, global crude production dropped for 4 consecutive years, and in 1983 the demand was about 53 million barrels a day (a drop of 0.5 percent from the previous year). (In 1984 there was a slight increase with 54 million barrels a day or a 2.4 percent rise compared to the previous year.)

Under such circumstances, the crude spot oil market softened considerably since early this year, and global demand and supply continue to ease.

(Note: The crude spot price was affected by: 1) an increase in crude exports by Saudi Arabia based on its netback formula, 2) a warm winter in Europe, and 3) a declaration concerning share protection at the OPEC general meeting in December of last year. As a result, it turned weaker in mid-December and dropped sharply in January of this year. Subsequently, based on an agreement to raise the production ceiling at the OPEC special committee meeting that ended on 4 February, the crude spot price has been showing a further softening trend. "Brent" crude (Britain) declined from \$30/barrel in mid-November 1985 to \$15.40/barrel on 5 March 1986. "Oman" crude (Oman) dropped from \$27/barrel in mid-November 1985 to \$11.85/barrel on 5 March 1986.)

(2) Energy demand in Japan has declined since the second oil crisis, reflecting progress in energy-saving, a change in the industrial structure and a lag in business recovery for four consecutive years. The total supply of primary energy decreased continuously by more than 3 percent from FY 80 to FY 82, but it rose by 5-6 percent in FY 83 and FY 84, centering on the industrial sector.

Nevertheless, in terms of energy resources, while the oil supply has declined broadly since the second oil crisis on the one hand, the oil-substitute energy supply has made solid progress. As a result, dependency on oil in FY 84 dropped to 59.6 percent. The comprehensive energy research committee convened in November 1983 estimated that Japan's dependency on oil will be 53 percent in FY 90 and 48 percent in FY 95. (See Table 1)

(3) Energy affairs at home and abroad are thus in a softening trend. From a medium and long-term standpoint, it is highly possible that global oil demand will become tighter. In other words, according to many views beginning with that of the IEA [International Energy Agency], it is believed that with a rising oil demand based on a future global business recovery and a limited reserve of supply capability centering on OPEC, a tightening of the world's oil demand will recur in the 1990's. (See Table 2)

Also from an international viewpoint, Japan's dependency on imported energy remains high, and it depends for the bulk of its oil imports on the Mideast where the political situation remains unstable, thus underscoring its weak energy supply structure. (See Table 3)

第1表 長期エネルギー需給見通し(抄)

1. 供給構成	4. 57年度(実績)	7. 65年度	10. 70年度	13. 75年度(試算)
2. 総供給量	5. 38億kl (100%)	8. 6億kl (100%)	11. 3億kl (100%)	14. 6億kl程度(100%)
3. 石炭	6. 9,450万t (18.5)	9. 10,800万t (18)	12. 12,800万t (18)	15. 16,000~17,000万t (20程度)
原子力	1,730万kW(6.9)	3,400万kW(11)	4,800万kW(14)	6,200万kW程度 (16程度)
天然ガス	2,700万kl (7.0)	5,600万kl (12)	6,100万kl (12)	6,400~6,600万kl (11程度)
水力	3,340万kW(5.4)	4,000万kW( 5)	4,350万kW( 5)	4,850万kW程度 (5程度)
地熱	40万kl (0.1)	150万kl (0.3)	350万kl ( 1)	600~700万kl ( 1程度)
新エネルギー等	90万kl (0.2)	800万kl ( 2)	1,900万kl ( 4)	3,500~5,500万kl ( 6~9)
石油	2.4億kl (61.9)	2.4億kl (53)	2.5億kl (48)	2.5~2.6億kl (42程度)

16. (58. 11. 16 総合エネルギー調査会)

Table 1. Perspective on Long-Term Energy Demand (Extract)

Key:

1. Supply components
2. Overall supply
3. Coal
- Atomic energy
- Natural gas
- Water power
- Terrestrial heat
- New energy sources
- Oil

4. FY 82 (real figures)
5. 388 million kiloliters (100%)
6. 94.5 million tons (18.5%)
  - 17.3 million kilowatts (6.9%)
  - 27 million kiloliters (7%)
  - 33.4 million kilowatts (5.4%)
  - 400,000 kiloliters (0.1%)
  - 900,000 kiloliters (0.2%)
  - 240 million kiloliters (61.9%)
7. FY 90
8. 460 million kiloliters (100%)
9. 108 million tons (18%)
  - 34 million kilowatts (11%)
  - 56 million kiloliters (12%)
  - 40 million kilowatts (5%)
  - 1.5 million kiloliters (0.3%)
  - 8 million kiloliters (2%)
  - 240 million kiloliters (53%)
10. FY 95
11. 530 million kiloliters (100%)
12. 128 million tons (18%)
  - 48 million kilowatts (14%)
  - 61 million kiloliters (12%)
  - 43.5 million kilowatts (5%)
  - 3.5 million kiloliters (1%)
  - 19 million kiloliters (4%)
  - 250 million kiloliters (48%)
13. FY 2000 (trial balance)
14. About 600 million kiloliters (100%)
15. 160-170 million tons (about 20%)
  - 62 million kilowatts (about 16%)
  - 64-66 million kiloliters (about 11%)
  - About 48.5 million kilowatts (about 5%)
  - 6-7 million kiloliters (about 1%)
  - 35-55 million kiloliters (about 6-9%)
  - 250-260 million kiloliters (about 42%)
16. Comprehensive Energy Survey Committee, 16 Nov 83

第2表 世界の石油需給 (単位: 百万B/D)

2. 項目	1. 年	1980年	1985年	1990年	2000年
3. 世界の石油需要					
OECD		38.8	35	36	37
OPEC		2.9	4	5	8
非OPEC発展途上国		7.9	8	11	15
4. 計		49.6	47	52	59
5. 世界の石油供給					
OECD		14.8	15.5	14	13.5
OPEC		27.6	21	27~29	25~29
その他の		7.2	10	10	12
6. 計		49.6	47	51~53	51~55
7. 超過需要		—	—	1~-1	8~4

8. (出所) IEA

Table 2. Global Oil Demand and Supply (Unit: 1 million barrels/day)

Key:

1. Year: 1980/1985/1990/2000
2. Item
3. Global oil demand
  - OECD
  - OPEC
  - Non-OPEC developing countries
4. Total
5. Global oil supply
  - OECD
  - OPEC
  - Others
6. Total
7. Surplus demand
8. (Source) IEA

第3表 主要先進国におけるエネルギー供給構造比較 (1983年)  
(単位: 原油換算百万トン, %)

2. 事項	1. 国別	日 本	米	西 独	仏	英
3.	一次エネルギー供給量	350	1728	253	187	193
4.	一次エネルギーの輸入依存度	82.0	12.7	50.5	63.0	-20.5
5.	一次エネルギーの石油依存度	60.9	40.4	43.4	47.9	37.6
6.	石油の輸入依存度	99.7	30.1	95.2	97.3	-62.5
7.	輸入原油のホルムズ依存度	(*) 62.8	12.3	19.9	38.5	27.8
8.	一次エネルギーの中東依存度	35.3	1.2	5.3	14.5	—

9. (出所) OECD Energy Balances (1983年)

IEA Q. O. S. (1983年) 等.

(\*) 我が国統計 (「エネルギー生産需給統計」) ベースでは  
1984年の我が国原油輸入のホルムズ依存度は63.6%

Table 3. Comparative Energy Supply Structures in the Principal Advanced Nations (1983)

(Unit: 1 million tons of crude, %)

Key:

1. Nation: Japan/USA/West Germany/France/Britain
2. Item
3. Supply of primary energy
4. Import dependency on primary energy
5. Oil dependency on primary energy
6. Dependency on oil imports
7. Holmes dependency on imported crude
8. Dependency on the Mideast for primary energy
9. (Sources) OECD Energy Balances (1983)

IEA QOS (1983)

(\*) Japan's National Statistics [energy production and demand statistics] show that its Holmes dependency on crude imports in 1984 was 63.6 percent.

(4) In order to meet the aforementioned medium and long-term outlook for energy supply, it is necessary to promote development of oil-substitute energy technology, construction of oil storage bases and independent development of oil resources. However, since this will require long lead times, there will be a continued need for sound implementation of an energy policy based on a medium and long-term viewpoint in order to secure a stable supply of energy and to

seek a stable economic growth, as well as the improvement of the national livelihood.

Of course, judging from the recently alleviated demand and supply of energy, and in order to obtain a national consensus concerning the promotion of energy measures, we must do our utmost to implement an efficient policy by stressing not only the security aspect of energy, but also the medium and long-term aspects of its economics.

## 2. Structure of The Energy Measures Budget

(1) Continuous energy measures must be implemented from a medium and long-term standpoint, and this requires huge funds. On the other hand, there are comparatively few clear benefits from such measures, and the energy measures budget embraces a broad range of specific revenue sources and a special purpose tax system, in addition to general revenue sources. Therefore, aside from the general account, special accounts play a large role.

(2) In the general account, costs for basic research and costs for general energy administration are appropriated from general revenue sources. Also, with the oil tax as the revenue source, transfers to the 'special account for coal, oil and oil-substitute energy measures' are included in the appropriation.

In addition, with general revenue funds as the source, appropriations have been made for research promotion spending for peaceful uses of atomic energy under the jurisdiction of the Science and Technology Agency, for the International Atomic Energy Agency share funds under the Ministry of Foreign Affairs and for research and development funds for new energy and energy-saving technology under the Ministry of International Trade and Industry.

(3) Next, special accounts for energy measures include the aforementioned "special account for coal, oil and oil-substitute energy measures" and the "special account for electric power resources development and promotional measures."

Under the "coal account" of the first special account, accounting is done for domestic coal measures such as rationalization of the coal mining industry and regional promotion of coal production, with custom duties on crude and heavy oil providing revenue sources.

Also, under the "oil and oil-substitute energy account" of the first special account, accounting is done for such oil measures as oil storage, exploration and development, and for the development and introduction of oil-substitute energy (excluding those for power generating purposes). Revenue sources consist partly of custom duties on crude and heavy oil, and partly of oil taxes transferred from the general account.

Under the special account for electric power resources, development of power resources and promotional taxes provide the revenue sources. Accounting is done for power resource site measures under the "electric power resource sites account," and for the measures for power resources development through oil-substitute energy under the "electric power resources diversification account."

(Note) Part of the energy measures spending is also appropriated under the 'national schools special account.'

### 3. Outline of FY 86 Budget

Regarding FY 86 energy measures spending, every effort is being made to reevaluate various measures based on recent alleviated conditions of energy demand and supply and severe funding pressures, and to reduce costs while maintaining the basic framework of promoting sound conditions for the securement of stable energy supply from a medium and long-term viewpoint.

As a result, 629.7 billion yen or an increase of 0.1 percent compared to the early part of the previous year was appropriated as energy measures spending under the general account. Also, 1.661 trillion yen or an increase of 3.3 percent was appropriated for overall energy measures spending (net account) including the special account. In view of the fact that general expenditures of the general account were curtailed with a drop of 0.0 percent [as published] compared to the previous year, it can be said that energy measures spending was given a reasonable priority. However, in view of the fact that the growth rate of energy measures spending in the FY 86 general account was 4.2 percent (6.4 percent on a net account base for both the general account and special accounts), the goal of the FY 86 budget appears to be complete economization and rationalization.

The outline of the FY 86 energy measures budget is as shown in Table 4 (Table 5 in the case of the special accounts).

The main points are explained as follows.



第4表 81年度エネルギー対策費の概要 (単位: 百万円, %)

1. 区 分	2. 80 年 度	3. 81 年 度	4. 対前年度 増△減
5. 一般会計(主要経費)			
原子力平和利用研究促進費	(7.4) 165,700	167,708	(1.2) 2,008
国際原子力機関分担金等	(5.8) 2,633	2,578	(△2.1) △ 55
新エネルギー技術関係経費	(△17.2) 3,022	2,378	(△21.3) △ 644
省エネルギー技術関係経費	(△16.7) 1,264	986	(△22.0) △ 278
石 特 会 計 繰 入	(3.4) 455,000	455,000	(0.0) 0
そ の 他	(△4.1) 1,161	1,030	(△11.3) △ 131
小 計	(4.2) 628,779	629,680	(0.1) 901
6. 特 別 会 計			
電 源 開 発 促 進 対 策	(13.6) 248,023	270,788	(9.2) 22,765
電 源 立 地 勘 定	(14.3) 89,238	101,704	(14.0) 12,466
電 源 多 様 化 勘 定	(13.2) 158,785	169,084	(6.5) 10,299
石炭並びに石油及び石油代 替エネルギー対策	(3.6) 598,256	607,903	(1.6) 9,647
石 炭 勘 定	(△1.8) 125,850	123,540	(△1.8) △ 2,310
石油及び石油代替エネル ギー勘定	(5.2) 472,406	484,363	(2.5) 11,957
石 油 対 策	(4.9) 415,730	426,924	(2.7) 11,194
石油代替エネルギー対 策	(7.2) 56,676	57,439	(1.3) 763
国 立 学 校	(4.1) 11,480	12,713	(10.7) 1,233
小 計	(6.4) 857,759	891,404	(3.9) 33,645
7. 一般会計・特別会計合計 (重複分は除く)	(6.4) 1,031,538	1,066,084	(3.3) 34,546

Table 4. Outline of FY 86 Energy Measures Spending (Units: 1 million yen, %)

Key:

1. Item
2. FY 85
3. FY 86
4. Increase/decrease from previous year
5. General account (Principal costs)
  - Research and promotional spending for peaceful uses of atomic energy
  - International Atomic Energy Agency share funds
  - New energy technology spending
  - Transfer to special account for coal, oil and oil-substitute energy measures
  - Others
  - Subtotal

6. Special accounts
  - Electric power resources development and promotional measures
    - Electric power resource sites account
    - Electric power resources diversification account
  - Coal, oil and oil-substitute energy measures
    - Coal account
    - Oil and oil substitute energy account
      - Oil measures
      - Oil-substitute energy measures
  - National schools
  - Subtotal
7. General account/special accounts total  
(Overlapping portions are excluded)

Table 5. FY 86 Energy-Related Special Accounts Budget [table follows key]

Key:

1. (Unit: 100 million yen)  
( ) FY 85 budget amount
2. Oil tax  
Oil 4.7%  
LPG, LNG (including domestic natural gas) 1.2%
3. Duties on crude and heavy oil  
640 yen/kiloliter
4. General account
5. Electric power resources development and promotional tax  
44.5 sen/KwH
6. Tax revenue  
1,138 (1,153)  
Surplus funds  
97 (106)
7. Tax revenue 1,269 (1,245)  
〈Coal, oil and oil-substitute energy measures special account〉
8. Tax revenue 131 (92)
9. Transferred to coal, oil and oil-substitute energy measures special account 4,550 (4,550)  
Surplus funds 163 (82)
10. Tax revenue  
1,519 (1,436)  
Surplus funds  
172 (152)
11. Tax revenue 2,371 (2,242)  
〈Electric power resources development and promotional measures special account〉
12. Tax revenue  
852 (806)  
Surplus funds  
165 (86)
13. Coal account
14. Oil and oil-substitute energy account

15. Electric power resources diversification account
16. Electric power resources site account
17. Total - 4,844 (4,724) 25%
18.
  1. Rationalization and stability measures
    - Subsidies for mine framework maintenance and expansion projects
    - Subsidies for mining industry stability
    - Subsidies for mine safety projects
    - Consignment costs for mine safety technological surveys
  2. Mine damage and disaster measures
    - Mine damage rehabilitation subsidies
  3. Promotional measures for coal-producing areas
    - Emergency subsidies for advancement of coal-producing areas
  4. Labor Ministry share
  5. Others
19. (Oil measures)
  1. Development
    - Investment loans for exploration
    - Research and development for oil development technology
    - Basic research on domestic oil and natural gas
    - Remote sensing technology for oil resources
    - Subsidies for natural gas exploration
  2. Stockpiling
    - Measures to build up national stockpiles
    - Aid for stockpiling civilian oil
    - Aid for stockpiling LPG
  3. Upgrading the industrial system
    - Measures to strengthen the oil industrial system
    - Development of technology for heavy oil measures
    - Technological development of new uses for light residual oil
    - Research and development on new fuel oil (in particular, use of methanol as automobile fuel)
    - Projects to secure high quality benzine
    - Advanced technology and research on oil supply stations
  4. Others
    - Total
20. (Oil-substitute energy measures)
  1. Measures to secure supplies
    - Loans for overseas coal exploration, guarantee of development debts
    - Research on overseas geological formations
  2. Measures for promotion of imports
    - Loans by the Japan Development Bank
    - Promotion of imports by small and medium companies
    - Promotion and dissemination of solar systems
    - Local energy
    - Natural gasification of local municipality gas businesses
  3. Technological development
    - Coal liquefaction technology
    - Common base substitute energy technology
    - Substitute energy application subsidies
    - Coal production and utilization technology
    - Manufacture of hydrogen with use of coal

4. Others
  - Total
21. 1. Measures to secure supplies
  - Water power development
  - Terrestrial heat development
2. Introduction and promotion measures
  - Subsidies for coal thermal power construction
  - Confirmation of coal thermal power development technology
3. Technological development
  - Solar energy technology
  - Terrestrial heat energy technology
  - Coal energy technology
  - Fuel battery
  - New battery power storage system
4. Atomic energy
  - Nuclear fuel cycle research
  - Corroborative testing of light water reactor modification technology
  - New converter reactor demonstrator
5. Share burden of Science and Technology Agency
6. Others
  - Total
22. 1. Subsidies for electric power resources sites promotional measures
2. Special subsidies for electric power resource sites
  - Subsidies for peripheral areas of atomic energy power generation facilities
  - Subsidies to prefectures for transfer of electric power
3. Subsidies for peripheral areas of water power generation facilities
4. Consignment costs for atomic energy power generation safety measures
5. Subsidies for atomic energy power generation safety measures
6. Grants for atomic energy power generation safety measures
7. Others
  - Total
23. Total for coal, oil and oil-substitute energy measures special account
24. Total for electric power resources development and promotional measures special account
25. Total for special accounts

第5表 昭和61年度エネルギー関係特別会計予算

1. (単位: 億円)	
( ) 60年度予算額	
2. 石油税	
石油 4.7%	
LPG、LNG (国産天然ガスを含む) 1.2%	
3. 原油重油関税	
640円/ℓ	
4. 一般会計	
5. 電源開発促進税	
4.45銭/kwh	
6. 税収	
1138(1153)	
剰余金等 97(106)	
7. 税収	
1269(1245)	
8. 税収	
131(92)	
9. 石油及び石油代替エネルギー関係特別会計	
10. 税収	
1519(1436)	
剰余金等 172(152)	
11. 税収	
2371(2242)	
12. 税収	
852(806)	
剰余金等 165(86)	
13. 石炭勘定	
14. 石油及び石油代替エネルギー勘定	
15. 電源多様化勘定	
16. 電源立地勘定	
17. 合計	
4,844(4,724)	
25%	
18. 1. 合理化安定対策	
375(387)	
2. 鉱務対策	
514(514)	
3. 炭坑地帯振興対策	
80(83)	
4. 労働者分	
175(179)	
5. その他	
29(28)	
19. (石油対策)	
1. 開採	
1263(1,321)	
2. 備蓄	
2785(2,633)	
3. 産業別削減等	
185(167)	
4. その他	
37(36)	
20. (石油代替エネルギー対策)	
1. 供給確保対策	
43(42)	
2. 海外炭産地調査等	
23(22)	
3. 導入促進対策	
137(146)	
4. 開採資金	
48(56)	
5. 技術開発	
314(267)	
6. 原子力発電設備等周辺地域	
39(39)	
7. その他	
18(15)	
21. 1. 供給確保対策	
164(154)	
2. 原子力発電設備等周辺地域	
39(39)	
3. 技術開発	
314(267)	
4. 原子力発電設備等周辺地域	
39(39)	
5. その他	
18(15)	
22. 1. 電源立地促進対策交付金	
602(504)	
2. 電源立地特別交付金	
129(119)	
3. 原子力発電設備等周辺地域	
77(74)	
4. 交付金	
53(45)	
5. 電力移転等交付金	
23(28)	
6. 原子力発電設備等周辺地域	
39(39)	
7. その他	
18(15)	
23. 石油特会計	
6079(5983)	
24. 電源特会計	
2708(2480)	
25. 合計	
92%	
1,017(892)	
1,017(892)	

## (1) Oil Measures

Like the principal advanced nations, Japan is also diversifying its energy resources. Japan still depends on primary energy supplies for about 60 percent of its oil. Moreover, it depends on imports for almost the total amount (99.7 percent). Therefore, it is important for its energy measures to secure a stable oil supply.

From this standpoint, 426.9 billion yen or an increase of 2.7 percent compared to the previous year was appropriated as oil measures spending under the oil and oil-substitute energy account of the coal, oil and oil-substitute energy measures special account.

### 1) Oil Stockpiling

#### <Particulars and Present Conditions>

In view of the fragility of Japan's energy supply structure and its high dependency on the Mideast with its internationally unstable conditions, a careful stockpiling of oil reserves to protect Japan against an emergency situation in the form of a suspension of its oil supply line is considered to be an important pillar of its energy policy from the standpoint of its economic security.

Japan's oil reserves policy is implemented through a 90-day supply stockpiled by civilian oil companies and national reserves stockpiled by the Japan Oil Public Corporation.

First, regarding civilian reserves--civilian oil companies are required by the oil reserves law to stockpile a 90-day supply. As for reserves in excess of 'running stocks' (about 45 days' supply) that are necessary for company operations, the Oil Public Corporation provides low-interest loans for crude purchases and storage facility construction. It also provides necessary interest subsidies.

Meanwhile, in international terms, the average reserves of the IEA member nations as of 1 October 1985 equaled a 162 days' supply. In Japan's case, since its 90-day civilian reserves were inadequate, steps are being taken by the Oil Public Corporation for 30 million kiloliters of national reserves.

As a result, Japan's reserves at the end of December 1985 were: 50.73 million kiloliters (about 90 days' supply) of civilian reserves and 19.49 million kiloliters (about 35 days' supply or 20.52 million kiloliters on a crude base) of national reserves, totalling 70.22 million kiloliters (about 125 days' supply), in terms of oil products.

### FY 86 Budget

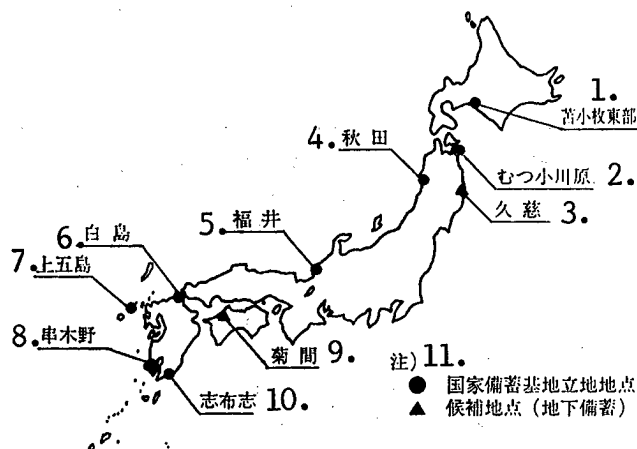
A decision was made in FY 86 to stockpile an additional 3 million kiloliters of national crude reserves above the accumulation in FY 85, and 65 billion yen has been appropriated to subsidize the borrowing of capital for crude purchases.

Also, of this volume, 9.3 million kiloliters can be stored in completed tanks on national storage sites. The remainder will be stored in empty civilian tanks until the national storage facilities are completed. Subsidies appropriated for the use of these (civilian) tanks total 99.3 billion yen.

As for construction of national storage facilities, seven sites have been selected so far, and construction in the Mutsu-Ogawahara district was completed last September. In FY 86, completion of construction is scheduled for the Fukui district and construction will continue on other selected sites. Regarding underground storage bases (preliminary designs are being implemented for three potential sites), plans for the start of construction are scheduled, premised on site selection and the establishment of storage companies. (See map) With these as goals, 30.2 billion yen has been appropriated in the FY 86 budget as subsidies to back up loans of 21.1 billion yen by the Oil Public Corporation and loans for facilities construction (190.6 billion yen in loans guaranteed by the government).

Regarding civilian reserves, a subsidy of 46.5 billion yen has been appropriated to maintain a 90-day supply of oil reserves. Also, civilian reserves of LPG [liquefied petroleum gas] are being maintained with a 50-day supply as the goal. The goal for FY 86 is a 40-day supply with an increase of 5 days' reserves, as well as an increase in the interest subsidy rate.

国家石油備蓄基地位置図



Map of National Oil Storage Bases

Key:

- |                    |  |
|--------------------|--|
| 1. Tomakomai East  | 8. Kushikino                             |
| 2. Mutsu-Ogawahara | 9. Kikuma                                |
| 3. Kuji            | 10. Shibushi                             |
| 4. Akita           | 11. Notes: ● National storage base sites |
| 5. Fukui           | ▲ Potential sites (underground storage)  |
| 6. Shiratori       |  |
| 7. Kami-Goto       |  |

## 2) Oil Development

The promotion of exploration and development of oil and natural gas resources at home and abroad has key significance from the standpoint of securing and dispersing supply sources, close cooperation with oil producing countries and of securing a stable supply of oil and natural gas.

About 60 companies are presently engaged in the exploration and development of oil throughout the world, including Japan, Southeast Asia and China. Among them, 17 companies (19 projects) have reached the production stage. The volume of independently developed crude was 23.4 million kiloliters in FY 84, constituting 11 percent of Japan's crude imports.

In FY 86, 135 billion yen in loans for exploration investment has been scheduled by the Oil Public Corporation, and 90 billion yen in necessary funds for this purpose has been appropriated from the coal, oil and oil-substitute energy measures special account. The scale of loans for exploration investment has dropped by 6 billion yen compared to FY 85, due to a thorough reexamination of the progress in target projects, based on the tight situation of the coal, oil and oil-substitute energy measures special account.

Also, regarding the promotion of oil development, a considerable portion of underground deposits expected to be explored is thought to exist in areas of technically difficult access such as deepsea and polar regions, and oil producing countries are emphasizing the technology of exploring countries vis-a-vis acquisition of exploration rights. It is therefore increasingly important to upgrade oil exploration technology. Thus, with respect to oil exploration technology, in addition to the current development of secondary and tertiary recovery technology, three new themes including technology for the analysis of the formation process for deposits will begin in FY 86, and 8.8 billion yen has been appropriated in the technological development budget for oil.

## 3) Upgrading of The Oil Industrial System

The oil industry in Japan is encumbered with such problems as a surplus capacity of constant pressure distilling devices, the existence of antiquated small and medium refineries and an uneven distribution of refinery sites, resulting in an inefficient system. Consequently, in order to upgrade the quality of Japan's oil industry and to secure an inexpensive and stable supply, it is necessary to improve the oil industrial system by striving for a rationalized and more efficient refinery system through a rapid disposal of surplus facilities, including the closing of refineries.

With this mind, it has been decided to implement oil refining rationalization measures (at a cost of 5 billion yen), centering on a measure to induce the scrapping of facilities, providing subsidies to oil refiners with closed plants to defray the cost of scrapping, and a measure concerning new development of technology for advanced use of oil refinery products.



Also, as a followup after FY 86, appropriations have been approved as refinery-related technology and development subsidies to the Japan Development Bank (900 million yen) for low-interest loans for the purpose of promoting the concentration of retail sales enterprises and the introduction of secondary facilities, and as application and development costs (4.4 billion yen) for heavy quality oil measures and technology.

## (2) Oil-Substitute Energy Measures

Japan's dependency on oil imports is still in excess of 60 percent, and this combined with the uncertain global oil situation places Japan's energy supply structure in a tenuous position. Further more, they are the reasons why the future forecasts a tight oil demand and supply situation from both a medium-term and long-term point of view. Even in the midst of an easing demand and supply, research and development of oil-substitute energy is promoted from a medium-term and long-term point of view in order to escape from dependence on imported oil. (Regarding the aforementioned outlook on the demand and supply of oil-substitute energy, the supply rate of oil-substitute energy is expected to rise to 47 percent in FY 90 and to 52 percent in FY 95.)

In order to strengthen oil-substitute energy measures in FY 86 also, 57.4 billion yen or an increase of 1.3 percent compared to the previous year has been appropriated for the coal, oil and oil-substitute energy measures special account, and 169.1 billion yen or an increase of 6.5 percent from the previous year for the electric power resources diversification account. Also, in the general account, 170.1 billion yen (a 0.8 percent hike from the previous year) has been appropriated as costs related to atomic energy and new energy.

### 1) Oil-Substitute Energy Measures under the Goal, Oil and Oil-Substitute Energy Measures Special Account

Under the oil and oil-substitute energy account of the coal, oil and oil-substitute energy measure special account, measures to secure supply including exploration and development of overseas coal (4.3 billion yen); technological development of coal liquefaction and common base oil-substitute energy technology (37.9 billion yen) and measures to promote the development and use of regional energy (13.7 billion yen) will be implemented in order to promote the development and use of oil-substitute energy as primary energy.

### 2) Electric Power Resources Diversification Measures

Japan's electrical projects depend on electric power resources for about 30 percent of its oil thermal power (as of the end of 1984). According to the outlook on long-term electric power demand and supply by the Electric Power Enterprise Council (in November 1983), the aim is to lower this to about 15 percent by the end of FY 95.

Toward that end, the purpose of the electric power resources diversification account of the electric power resources development and promotional measures special account is to develop power utilization technology such as oil-substitute energy as atomic energy, water power, coal thermal power, terrestrial heat and solar energy to promote non-oil power resources and diversification.

In FY 86, technological development of jet (pressure) coal gasification, multiple-cycle power generation (at a cost of 2 billion yen), application and development of atomic energy power generation, including the construction of a new type of converter reactor and demonstrator (at a cost of 3.2 billion yen), and the construction of a high-speed breeder reactor prototype will be given priority for development.

### 3) Oil-Substitute Energy Measures Under the General Account

Regarding the development and use of atomic energy, 167.7 billion yen (a hike of 1.2 percent from the previous year) has been appropriated for spending on promotion of research on atomic energy for peaceful purposes. The funds will be used for research to insure the safety of atomic energy, for development of a new power reactor and for research on nuclear fusion.

Also, a so-called 'sunshine plan' has been implemented since FY 84 for the development of new energy including solar energy, terrestrial heat energy and coal energy. In FY 86, 2.4 billion yen has been appropriated to defray the costs. In addition, 22.5 billion yen has been appropriated for the aforementioned oil and oil-substitute energy account of the coal, oil and oil-substitute energy measures special account, and 17.3 billion yen for the electric power resources diversification account of the electric power resources measures special account, resulting in a total appropriation of 42.2 billion yen (a 3.6 percent cut from the previous year). (see Table 6)

第6表 サンシャイン計画関係予算の概要  
(単位: 百万円, %)

1. 事 項	260 年 度	3.61 年 度
太陽エネルギー	9,169	8,241
地熱エネルギー	7,336	5,976
石炭エネルギー	25,654	27,061
水素エネルギー	256	228
総 合 研 究	663	532
国 際 協 力	71	72
そ の 他	627	102
合 計	(10.0) 43,776	(△3.6) 42,211
一 般 会 計	3,022	2,378
特 別 会 計	40,754	39,833

4. (注) ( ) 内は対前年度伸率。

Table 6. Outline of the Sunshine Plan-Related Budget  
(Units: 1 million yen, %)

Key:

1. Item
  - Solar energy
  - Terrestrial heat energy
  - Coal energy

Hydrogen energy  
Integrated research  
International cooperation  
Others  
Total

General account  
Special accounts

2. FY 85

3. FY 86

4. (Note) Figure in ( ) shows growth rate compared to previous year

### 3) Electric Power Resource Site Measures

Demand for electric power is expected to grow steadily under a stable economic growth. On the other hand, the location of electric power resource sites often present difficulties due to the fact that benefits to the local community tend to be seen as less in general than those to industrial plant sites in other sectors, and because there is a deep-rooted uncertainty concerning the safety and environmental integrity of power generator sites.

Therefore, in the power resources site account of the electric power resource measures special account, a total of 101.7 billion yen (a 14 percent hike from the previous year) was appropriated for power resource site measures, including: promotional measure subsidies (60.2 billion yen) to promote power resource areas through the upgrading of public facilities, and consignment costs of 18.5 billion yen for atomic energy generation safety measures, including corroborative testing of the safety of atomic power generation facilities.

Also, regarding atomic power generation expected to play an important role in supplying Japan's future energy, in view of present site-locating difficulties and future construction plans, the special measure covering the unit subsidy for atomic power generation facilities (increased from 450 yen per kilowatt to 600 yen per kilowatt) under promotional subsidies for electric power resource sites will be extended until FY 90.

### 4) Energy-Saving Measures

For Japan with its fragile energy supply structure, energy saving is a very effective means to alleviate energy limitations from the standpoint of demand, and it is necessary to promote it steadily from a medium and long-term standpoint.

Accordingly, in FY 86, 12.5 billion yen (a 10.3 percent hike from the past year) was appropriated in the energy saving measures budget, including the general account and the special accounts. In particular, regarding energy saving-related technological development, centering on the so-called 'sunshine plan' that has been implemented since FY 78, 1 billion yen was appropriated in the general account and 11.3 billion yen in the special accounts (the oil and oil-substitute energy account and the electric power resources diversification account under the coal, oil and oil-substitute energy measures special account), totalling 12.3 billion yen (a 10.6 percent rise from the previous year). It will be spent for large-scale energy-saving related technological development,

utilizing such oil-substitute energy as fuel battery power generation technology and the all-purpose sterling engine. (See Table 7)

第7表 ムーンライト計画関係予算の概要

(単位: 百万円, %)

1. 事 項	2. 60 年 度	61 年 度
大型省エネルギー技術	10,464	11,815
高効率ガスタービン	1,207	1,880
新型電池電力貯蔵システム	2,201	3,170
燃料電池発電技術	4,776	3,190
汎用スターリングエンジン	1,673	2,231
スーパーヒートポンプ・エネルギー集積システム	607	1,345
先進的基盤的省エネルギー技術	227	195
国際研究協力事業	20	25
省エネルギー技術の確立調査	69	88
民間の省エネルギー技術開発の助成	195	123
省エネルギー標準化	32	23
その他	139	57
合 計	(15.8) 11,146	(10.6) 12,326
一 般 会 計	1,385	1,026
特 別 会 計	9,761	11,300

3. (注) ( ) 内は対前年度伸率。

Table 7. Outline of 'Moonlight Plan' Budget (Units: 1 million yen, %)

Key:

1. Item
  - Large-scale energy-saving technology
    - High-efficiency gas turbine
    - New model battery power storage system
    - Fuel battery power generating technology
    - All-purpose sterling engine
    - Superheat pump/energy storage system
    - Advanced base energy-saving technology
    - International research and cooperation project
    - Establishment and survey of energy-saving technology
    - Development aid for civilian energy-saving technology
    - Standardization of energy-saving
    - Others
  - Total
    - General account
    - Special accounts
2. FY 85/FY 86
3. (Note) Figure in ( ) shows growth rate compared to the previous year

## 5) Coal Measures

Regarding coal measures (domestic coal), such measures as rationalization and stability of the domestic coal mining industry, mine damage rehabilitation and advancement of coal-producing areas have been promoted under the coal account of the coal-oil and oil-substitute energy measures special account.

FY 86 is the final year of the 7th coal policy plan (from FY 82 to FY 86). Continuous effort toward better efficiency and higher priority is emphasized, and an appropriation of 123.5 billion yen (2.3 billion yen less than the previous year or a 1.8 percent cut) has been made.

Among the chief policies implemented, rationalization and stability measures include deriving lessons from recent mining disasters and upgrading safety measures by appropriating consignment costs for research on mine safety technology (600 million yen) and subsidies for projects to secure mine safety (9.3 billion yen). In addition, subsidies similar to last year (51.4 billion yen) have been appropriated for mine damage rehabilitation.

5884/13045

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24 July 1986

## METALLURGICAL INDUSTRY

## MEASURES TO COUNTER STEEL SLUMP DISCUSSED

Tokyo GEKKAN KORON in Japanese Apr 86 pp 112-115

[Unattributed report: "Investigation on Corporate Strategies"]

[Text] Earnings in the iron smelting industry rapidly improved after escaping from the "steel freeze" depression of 1982-83, which was the worst since the war, but then again took a turn for the worse in 1985.

By mid-September operating profits had already fallen across the board in comparison to the second half of fiscal year 1984. Heading the list was Nippon Kokan K.K. with a 44 percent decline. Sumitomo Metal Industries Ltd., Nippon Steel Corp., Kawasaki Steel Corp., and Kobe Steel Ltd., followed with declines of 30, 21, 19, and 14 percent, respectively. Production cutbacks have intensified since last fall due to depressed exports, caused by U.S. import controls and lowered exports to China, in combination with declines in domestic demand and a recession caused by the high yen. Profits for the last half of the year will barely be maintained with the possibility of going into the red if the situation is not handled properly.

During the first quarter of 1986, domestic crude steel production was cut back from 25 to 23 million tons, and the present estimate for total 1986 crude steel production is that it will unavoidably be less than 100 million tons.

#### Iron Smelting Companies Plan For Personnel Reductions

According to the long term forecast of the executive office of the International Steel Association, world steel consumption will be 750 million tons in 1995, which represents a yearly growth rate of 0.4 percent from 1985 through 1995, and the growth for Japan will be zero. Because of this, steel companies are being pressed to expand economic opportunities in rapid growth areas by combining a switch to higher value added products with a further rationalization of their steel divisions in order to maintain commercial growth.

Beginning in 1984 Nippon Steel implemented the third stage of its rationalization plan centered on the intensification of product diversification and on a production tendency moving in the direction of integrated

iron production plants. From last fall up through this year, other iron smelting companies, one after the other, have been announcing medium and long range plans for the remainder of the 80s. The major elements of these plans are personnel reductions in steel divisions and expansion into new enterprises.

Nippon Kokan K.K. is taking the course of reducing the steel division's current 21,000 person work force by 20 to 30 percent over the next five years through natural reductions and through employee redistributions and transfers to new enterprises.

Sumitomo Metal Industries Ltd. has also put together a new mid-range management 3-year plan that involves the reduction of 3,800 persons employed in its steel divisions over 3 years beginning in 1986, and the expansion of non-steel sales by 50 percent.

In mid-January, Kawasaki Steel Corp. also announced a new 5-year plan to replace its former 3-year plan. The essence of the plan is the long term goal of reaching sales of 2-trillion yen by the year 2000, which is the 50th anniversary of the company's founding, of which 40 percent would be non-steel related (30 percent, or ¥600 billion, would be accounted for by new enterprises). In conjunction with this, the 5-year plan has the goal of reaching ¥1.4 trillion in sales during 1986, the first year of the plan. This would be an actual growth rate of 3.5 percent. Of this, steel sales would account for ¥1.15 trillion and engineering, chemical, and other new enterprises would account for ¥250 billion in sales.

In order to increase personnel and investment efficiency, steel divisions are emphasizing technological strength and the intensification of product strategies. In addition to the product value, the tendency is to specialize in specialty areas through technological development, especially in the areas of stainless steel, electroplated steel, surface treated steel plates, etc.; through the filling out of production and sales; and through a reduction in unprofitable products. In order to maintain international competitiveness, companies are also developing, as well as advancing through the aggressive importation of new processes and production technologies, and are aiming to decrease costs by 3 percent per year. Even though there are currently 18,500 on-site employees in steel divisions, a system has been established that will lower this number to 14,000 persons after 5 years including a natural decline of 2,000 persons.

Such a trend towards complete efficiency may possibly reduce formerly allocated investment funds to two-thirds, and the plan is to use the remaining third as start-up capital for new enterprises.

In one direction, non-steel divisions are planning to increase sales in existing engineering enterprises by ¥120 billion while at the same time restoring profits by strengthening foundations and advancing into new enterprises. Chemical enterprises will have increased sales of ¥90 billion through the nurturing of efforts in the new fields of carbon fibers, magnetic materials, and silicon; and advances into other new enterprises such as

large-scale integrated circuit (LSI) companies will increase sales by ¥40 billion. Through this, non-steel enterprises will account for 17.9 percent of increased sales after 5 years.

#### Towards New Raw Materials Through Chemistry

The enterprise diversification of iron smelting companies, or the move towards the full-scale integrated management style of entering new fields, began with the aim of escaping the reliance on steel and the limitations imposed by the "steel freeze" depression of 1982-83. Corporate expansion began in engineering areas after the oil shock and also involved new basic materials, coal chemistry, real estate, high rise dwellings, animal husbandry, and plant breeding; but basically this advance into peripheral enterprises was a search for measures that would have an immediate effect on countering the depression and on countering the overemployment that was caused by production cuts.

However, even though they are basically in areas that take advantage of technology and know-how amassed in the steel industry, more recent new enterprises have the distinct characteristic of stipulating that expansion opportunities be in the direction of growth areas and that the number one priority be on growth maintainability and high added value, as represented by the positive response of the material revolution that targeted the synthesis of new basic materials.

In order to satisfy these requirements, companies do not rely on their own technological strength, but are very enthusiastically getting started through technology imports and company buy-outs.

There are various differences between the evolutionary paths followed by each iron smelting company, but the tendency is first to begin with chemical products based on coal chemistry such as carbon materials and gas chemistry; secondly to move on to new basic materials such as new ceramics, titanium, and amorphous materials; and thirdly to be able to develop overseas strategies through company buy-outs and capital participation in the United States and Europe.

Kawasaki Steel Corp., one of the five major iron smelting companies, moved cautiously and only into new fields that had a heavy emphasis in steel. Now after 2 to 3 years of targeting new basic materials, the advances of its new companies are drawing a great deal of attention.

Kawasaki Steel Corp.'s chemical divisions, like those of Nippon Steel, had an existing reputation even in the steel industry for strength in technological development, and so new enterprises first looked towards the chemical field. Kawasaki Steel intended to expand by absorption and merger of the subsidiary companies that had been nurtured up through April of 1984, while at the same time establishing a "chemical research center" in November of 1984 that strengthened its theme of narrowing its target to leading edge fields such as carbon fibers, fine chemicals, and C<sub>1</sub> chemistry.

Chemical enterprises within the steel industry began through the use of by-product gases that were produced during the manufacture of coke. Even



though ceramics is becoming the foundation for heat resistant furnace materials technology, there is already a plant in operation that separates and produces very pure carbon monoxide from by-product gases. The raw materials used in C<sub>1</sub> chemistry are starting to be utilized, and research in the area of fine carbons is being carried out using the by-product coal tar as the raw material, and a test plant that uses KMFC raw materials for isotropic carbon materials is starting up. Because of its superior physical properties the demand for DMFC for use in machine parts and in crucibles used for semiconductor manufacturing has grown rapidly, and a facility that will produce 30 tons per month will be established this fall.

The production of carbon fibers from coal pitch, which is currently the center of attention, will plunge into full-scale operations with the completion of a pilot plant, and along with Nippon Steel, Kawasaki Steel Corp. will be a pioneer. Because PAN fibers (polyacrylic nitrile), which are currently filling the role of carbon fibers, are not as cost effective, the demand for carbon fibers after a few years is expected to be large.

Kawasaki Steel Corp.'s intended course was to focus on expanding into new basic materials, primarily in the fields of amorphous materials, fine ceramics, steel fibers, silicon wafers, powder metallurgy, composite materials, etc., that avoided competition with other companies. However, opportunities involved in the new enterprise developments of 1984 and the founding of new basic materials enterprises in 1985, along with the cooperation of businesses in other fields and foreign capital, have led to increased levels of corporate buyouts.

#### Aiming To Purchase U.S. Firm NBK

The first forward push was the advance into the growth areas of semiconductor related markets. Strategic development is in vain if its only aim is to escape dependence on the steel industry and join the ranks of existing engineering and chemical companies. Nippon Steel received technological aid from Hitachi Ltd., with the aim of nurturing the technology through practical use in subsidiary companies, and thereby took the route of cooperation into new business fields where it had no experience.

Entry into the silicon wafers industry was also initially achieved through the purchase of NBK [TN: not further identified], a U.S. silicon wafer manufacturer, for \$9.36 million. In addition to having the technology, NBK also had a 2.3 percent share of the U.S. market. In this way the investment risk associated with selling the goods, which would be present if the manufacturing took place in Japan after acquiring the technology, can be kept to the lowest possible levels. The time of purchase happened to coincide with a depression in the semiconductor industry, but in the long run it will be a high growth industry and when it recovers there is the possibility of reversing the exports back to Japan, and the company is full of confidence that the results can be doubled.

In reality, gains from the purchase of NBK were not limited to production technology, but business strength in areas with no previous experience was

also acquired and previously calculated results are being surpassed. By 1984 sales had doubled to \$10 million after only two years and it appears that the 5-year goal of increasing sales by four-fold to \$40 million will be fully achieved.

Foreseeing a need to respond to the trend towards large diameter silicon wafers, NBK had already developed a production system for 6-inch wafers with production beginning late last year, and there is even a hidden potential to make better than expected progress in the Japanese market which is in the 5-inch wafer mainstream. In addition to having the technological ability to tackle rapidly a plan to produce even 8-inch wafers, the fact that NBK also has an existing sales network set up to supply approximately 20 major U.S. semiconductor manufacturers, including National Semiconductor and Motorola, cannot be ignored.

More than was expected, the progress of Kawasaki Steel Corp.'s semiconductor enterprise caused the world to realize that it was an all-out administratively strategic enterprise. From the moment that NBK was bought out, inroads were made into the custom LSI field and the LSI logic area through joint ventures and cooperation with major U.S. semiconductor manufacturers.

Custom LSI can be classified by use in the general categories of memory and logic. In general terms, the latter involves digital LSI where there are assorted full- and semi-customized logic circuits according to customization standards, and which generally implies a product that is specially ordered by a customer.

The Japan Semiconductor Company was established as a joint-venture company where an LSI logic company put up 55 percent and Kawasaki Steel put up 45 percent of the financing (which initially came to \$45 million or ¥11.2 billion [at the time of announcement] and which will increase in stages). With ¥20 billion of invested capital, an initial plant will be constructed capable of putting out 20,000 wafers per month, and subsequently second and third plants will be established within the next 5 years. The total investment amount will be ¥50 billion and sales are forecast to be on the scale of ¥50 billion.

A 70,000 square meter lot has been acquired for the new plant in the Tsukuba industrial complex in Ibaragi Prefecture. Construction is scheduled to begin this spring and operations are scheduled to begin next spring.

#### Scouting For Future Needs

The new plant will produce semi-finished products for use in standard cells and in the master slice used in gate arrays, and then the product will be supplied to a group of LSI logic companies that will further process the goods and supply them to end users. As such, the risk associated with a new company can be avoided by having the production base that is characteristic of LSI logic companies.

However, even though the semi-finished products have only a small added value, this does not mean that Kawasaki Steel Corp. is in the position of

being limited to a small number of suppliers. Entry into the semi-finished product area was to meet the aim of expanding once the technology was learned, "To join the front lines as soon as possible by choosing a steady course," (Executive Director Shinsaburo Kato).

In order to accomplish this, Kawasaki Steel Corp. established an LSI logic company and the Japan Semiconductor Company. It is set up so that over a 5-year period, Kawasaki Steel Corp. will be provided with extensive semiconductor technologies from the LSI logic company, such as CAD (computer aided design), design automation, and wafer production processing technologies. Currently, the LSI logic company is the world's top company in the complementary metal-oxide semiconductor (CMOS) gate array field, and possesses superior software technology capabilities (with a complementary MOS, the semiconductor is composed of a circuit that is joined through the alignment of an n-channel MOS that carries an electron with a p-channel MOS that carries an electron hole).

If that technology can be acquired, the next step involves the commencement of mass memory production and the possibility of entering a specialized LSI area.

Since there is already a limitation on the existing staff's number of researchers and technologists in the area of new basic materials and in areas that the new companies have entered, scouts are setting out to secure talented persons along the way.

#### Entry Into Magnetics With Pechiney

Following semiconductor enterprises, the next shot at new enterprises will be the entry into magnetics. Since this field is very familiar both in terms of technology and sales, entry into the field in the near future was expected early on. On the technology side, steel companies are already familiar with the production of such representative items as electromagnetic steel plating, a magnetic metallic material; oxidized steel which is a ferrite material; and metallic oxides [calcined calx] a refined product. Even on the sales side, they have a thorough knowledge of the actual state of magnet users.

However, in this field, just as in semiconductors, Kawasaki Steel is looking for foreign capital for the strategic arrangement of its enterprises.

The partner is a representative European magnetics manufacturer called Ugimag S.A., a subsidiary company of the Pechiney Group which is centered on the diversified state-operated French firm Pechiney S.A., which deals in non-ferrous metals, ceramics, carbon, magnetics, etc.

The new enterprise will be a joint venture financed equally by Kawasaki Steel and the Pechiney Group (initial capital of ¥4.5 billion) and will be directed by Nihon Ugimag. A new plant will be established in the Kanto region with construction beginning this spring and operations slated to begin next fall. The investment will require a total of ¥10 billion over

4 years and initially 220 tons of ferrite magnets will be produced per month. Product types and amounts will be gradually expanded and by the 5th year of operations, sales are forecast to reach the ¥10 billion level.

There was ¥95 billion worth of magnets produced in this country in 1984, which, aside from the world's new basic materials enterprises, constituted a leading 40 percent share of the market; and for the time being, an annual growth rate of 10 percent, like that in the electronics and mechatronics industries, can be maintained. In terms of sales, it also appears that through cooperation with the Pechiney Group, a network to supply overseas markets can be established in the near future.

At a glance, the entry by the steel industry into the new material areas of non-related industries, beginning with electronics materials, appears to be a dangerous gamble; however, most of these new basic materials involve technologies that are extensions of steel technology such as coal-related technology, technology involving furnace materials that can withstand high temperatures and pressures, and crystal analysis technology. It should be noted that new technologies are in active areas created by needs, and the response to the needs, that are occurring in new markets.

Accordingly, it can also be said that they are fields that must be entered sooner or later in order to respond to the expanding requirements for materials of every function and to the growth in construction materials.

There are a surprising number of people asserting that the probability for success is low, even for the extremely powerful steel companies, when trying to embark on undertakings in already developed areas such as semiconductors and then chasing after companies that are competing to put these new technologies into practical use.

#### Potential, Limitations of Very Large Enterprises

The premise is that a steel manufacturer that has been using tons as the unit of measurement cannot switch to a precision trade that requires the accuracy of grams or microns, or as it were, to a trade of a different character.

Nevertheless, for the past 10 years, iron smelting companies have had a large beneficial influence on the nature of manufacturing and on production control technologies such as product quality controls and process controls. It is therefore easy to see that there is room for an iron smelting company to rapidly transform into the menacing rival of even a leading company if only the technology can be acquired.

Currently there are few large companies among the front runners of the much talked about silicon wafer industry, and investment activities to respond to these circumstances are also lacking.

In addition, because steel companies have been bold leaders in technology and, from a medium and long term point of view, have repeatedly made large

investments, they are better able to resist short term market fluctuations and are accustomed to price competition.

As can be expected, the extent to which it will contribute to profits is not known, but it is not hard to imagine that even in the semiconductor industry steel companies will survive the turning points and in periods of growth will constitute one corner of the front runner group.

#### Strengthening Primary Product Steel Comes First

After 5 years, non-steel divisions, including new enterprises, will account for 18 percent of sales. At that time, however, steel companies will probably not be able, as before, to escape overdependence on steel for their income. Even if the transition to new basic materials and new enterprises proceeds smoothly, the effect on profits will probably not surface until the first half of the 1990's. Until then, steel companies must endeavor to secure profits by placing their emphasis on technological competitiveness in steel and on product development abilities.

Along the lines of the high added value strategy in the new medium range 5-year plan, Kawasaki Steel Corp. would like to concentrate on the strategy of renovating the Mizushima steel factory from a plant specializing in thick plate, hot rolled steel to a plant that is an integrated thin plate steel factory.

Beginning with the mid-year completion of the cold rolled steel facility, a total of ¥100 billion will be invested in strengthening electroplated and magnetic steel plate and other high value added thin plate product facilities. Once these investments are completed, the intention is to transform the Mizushima steel plant into an integrated thin plate steel plant that is a world-class competitor.

It is remarkable that the steel plate producer Kawasaki Steel Corp. has taken a step towards specializing in surface treated steel plates, and by taking a reverse course away from integration has taken on more the corporate character of a steel manufacturer.

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## SCIENCE AND TECHNOLOGY POLICY

### TRENDS IN INDUSTRIAL STANDARDS IN NEW TECHNOLOGY DISCUSSED

Tokyo DENSHI KOGYO GEPPU in Japanese Oct 85 pp 47-61

[Article by Japan Industrial Standards Investigation Committee]

[Excerpts] I. Introduction

Since the enactment of the Industrial Standardization Rule in 1949, the industrial standardization project has been pushed forward by giving priority to the establishment of the Japanese Industrial Standards (JIS) and the conduct of the JIS mark indication system for the purpose of the rationalization of production, distribution, and consumption. This project has made a great and versatile contribution to various areas such as the growth of industries, promotion of commerce, and improvement of living.

In recent years, however, there have been remarkable changes in technological revolution, the drastic evolution of the information system, and the movement of internationalization. Proceeding with standardization, a new and long-range plan based upon a change in the recent social and economic state has been demanded. The first Tokyo General Meeting for the ISO (International Standardization Organization) was held in September 1985, followed by the IEC (International Electrotechnical Commission) Tokyo meeting. The chairman of the ISO is the first to have been elected from Japan. The time to examine international affairs approaches with the start of international standardization. Accordingly, the Japanese Industrial Standards Investigation Committee established the Industrial Standardization Promotion Long-Range Plan Review Special Committee under the Standards Council in February 1985. Although they had only a short time, the committee produced a report on plans for long-range industrial standardization.

This report consists of four sections. In Section I, 'Change in Social and Economic Status and the Basic Direction of the Standardization Administration' was discussed in general. In Section II, 'The Subject and Trend of the Standardization Administration in the Future' was pointed out, centering around standardization of the technology infrastructure in the age of fast technological progress. In Section III, 'Promotion of International Standardization Project' which was becoming more important in recent years was discussed. Finally, in Section IV, with regard to the four different fields, i.e., information technology, new materials, FA (Factory Automation); robots;

mechatronics, and biotechnology; each item was taken up and then the concrete way to proceed with standardization was included in a report, 'Proceeding With Standardization in New Technological Fields.'

The outline of this report and the way to proceed with standardization in the chief new technological fields follows:

## II. Outline

### (1) Correspondence to Internationalization

#### -1- Improvement of the JIS Mark Indication System (Action Program Related)

##### a. Inspection for JIS Mark Indication Approval

The JIS mark indication system is utilized by a foreign enterprise which does not have a brand image as means of entering into the Japanese market. It is considered that this system will play an important part in the expansion of import in the future. Therefore, in order to eliminate the geographical and linguistic handicap of a foreign plant and to make JIS mark indication easy, it is desirable to have an inspection institute of a foreign country execute plant inspection for a Japanese institute in the spot when the approval of JIS mark indication is requested by a foreign enterprise.

##### b. Reconsideration of Specified Items of JIS Mark Indication

Because of the trend of technologies demand structure, a change in the custom of business, and so on, specified items are going to be looked at again based upon the standards such as ease with which a consumer may himself observe the quality of a product, thereby reducing the necessity for other quality assurance.

#### -2- Internationalization of JIS

##### a. Assurance of Adjustment Between JIS and International Standards

In addition to the adjustment of JIS to international standards along with the existing fundamental policy, the following actions are going to be taken:

(a) The JIS is going to be actively taken into deliberation for international standards.

(b) If there is a difference between the JIS and international standards, its contents and necessity are disclosed inside and outside, and then an attempt is made to obtain international consensus.

##### b. Assurance of Clarity During the Process of JIS Preparation

To assure clarity during the process of JIS preparation, the participation of foreign specialists in the JIS draft preparation committee has been granted for some time. From now on, information on a draft preparation plan is going to be announced more widely to better public relations, and many more

participants from foreign countries are expected. In addition, executives of foreign affiliates in Japan are asked to become members of the Japanese Industrial Standards Investigation Committee. Participation and cooperation are expected.

### -3- Positive Contribution Toward International Standards Establishment

#### a. Acceptance of a Secretary for International Standards Establishment Worldwide Conference

International standards draft for the ISO and the IEC is enacted through several committees organized by specialists from each country, such as a TC (Technical Committee), SC (Sectional Committee), and WG (Working Group). Each committee nominates some country as for an executive secretary. The number of nominations for Japan is only a few when judged from the technological power of Japan in each industrial field. It is necessary to improve this situation, i.e., Japan is going to be more responsible for the nomination of an executive secretary for an international standards establishment committee. Especially, in the field of which the deliberation system for the ISO and the IEC has not been well prepared, Japan is going to exert every effort to be the country which provides the executive secretary by proposing a new theme.

#### b. Strengthening of Domestic Deliberation System

In order to bring internal opinions on an international standards proposal to a conclusion, deliberations are presently being carried out under a nongovernmental committee. From the viewpoint of making the best use of private resources, the understanding of top management of private corporations is to be solicited to assure a firm financial foundation and to strengthen the system.

### (2) Correspondence to New Technology and Information Development

In the age of rapid technological progress, not only the standardization of developed technology but also the standardization of technological development (technology infrastructure) are very important. That is, in the field where there is rapid technological progress, to proceed with standardization from the earliest stages seems to be requisite for efficiency in technological development and assuring mutual application of the system. Furthermore, it is important to clarify a concept by the unification of terminology, measurement methods, and testing procedures, and also important to put competitive conditions of technological development in order by ensuring mutual comparison of various data. In doing so, thoughtful consideration should be required to prevent technology from becoming stagnant due to standardization, and to accelerate the growth of technology with standardization. Thus, the following are needed:

-1- Substance and Strength of Investigation: A grasp of user's needs which shows a high degree of diversification, an investigation of the trend of international standardization, and substance in the investigation and research of test evaluation methods.



-2- Harmony of the Standard System: assurance of the conformity of various internal standards centering around the JIS, more practical utilization of the functions of organization standards.

### III. Stimulation of Standardization in New Chief Technological Fields

#### 1. Information Technology Field

##### (1) Trend of Technology

A computer which was developed for scientific calculation in the 1940's in the United States, gained its application for business in the 1950's. It was connected to a communication network at the beginning of the 1960's. At the same time, there were not only the introduction of the on-line system, TSS (Time-Sharing System), and real-time processing system, but also the advancement of terminal machines and peripheral equipment. The convenience of a computer itself is important from the viewpoint of interchangeability and expansion capability. A product form called a family series has been recently seen. In the United States the utilization of a communication network by a computer was liberalized in the 1960's, and the development of a network system was well observed. In Japan, various kinds of restrictions in a system are gradually taken away, and the age of a full-scale network has almost started.

On the other hand, the world-wide trend from the last half of the 1970's saw the advent of a personal computer and an intelligent office machine. Their use was limited to special environments up to that time. But since then, their application has been expanded to an ordinary office, factory, and home. Information technology has been popularized to a certain extent. Furthermore, a local area network (LAN) which connects machines in an office and plant is gradually progressing.

##### (2) Present Situation of Standardization

#### -1- Present Situation of the JIS

Regarding standardization of information technology, in consideration of its importance, great effort has been underway for a long time to establish the JIS. With respect to general terminology, character and coding, character recognition, input and output medium, programming language, data communication, and data code, a total of 84 cases of the JIS have been established up to this time. When other items, such as micro-graphics are included, 94 cases have been already set up. Among them, main JIS standardization encompasses information process terminology and Chinese character symbol system for information exchange in the basic field; keyboard arrangement and flexible disk cartridge (200-mm, 130-mm) for input and output medium; FORTRAN, COBOL, and BASIC for programming languages; basic data transmission control procedure and high level data control procedure in the data communication field; and Japanese document exchange file specification and Japanese document processing character arrangement in the office automation (OA) field.

## -2- Present Situation of International Standardization

International standardization in the information technology field is accomplished by the ISO/TC97 (information process system), ISO/TC46 (documentation), ISO/TC171 (micro-graphics), ISO/TC184 (production automation system), IEC/SC47B (micro-processor system), and IEC/TC83 (information equipment). The ISO/TC97 centers on this standardization. The JIS standards described before attempts to be in conformity with the international standards established by these organizations. Presently, due to growth in the information technology field, the adjustment and cooperation in the working area among the international organizations such as the ISO, IEC, and CCITT (International Telegraph and Telephone Consultative Committee) have become necessary. The ISO and IEC have started investigation cooperation with related international organizations, makers, and users.

### (3) Field Needed for Standardization

#### -1- Network

a. As a computer network expands among various companies and even among various types of industries, the standardization of protocol becomes more important. Internationally, the large number of standards called the OSI (Opening-Typed System Interchange) is scheduled to be systematized; presently, about 70 standards are planned to be placed. In preparation for the expansion of the network system in the future in Japan, it is strongly desired to introduce the OSI as the internal standards in order to cooperate with other countries in an international sense.

For the moment, by ascertaining the trend of the international standards in the future, it is necessary to start the work for the standardization of the JIS as soon as possible, and to establish the international standards and the JIS at the same time.

Concerning the study of the various standards related to the OSI in the ISO in the future, inherent problems for Japan such as the treatment of Chinese character code are to be involved. Therefore, for Japan's opinion to be fully reflected, the domestic deliberation system should be enriched. Furthermore, the standardization of the JIS should be carried out in concert with the establishment of international standards.

In addition, in order to realize the practical use of the mutual connection between systems under the OSI, it is necessary to proceed with study of problems such as treatment of a subset, and detailed connection specifications in cooperation with other countries.

b. Various kinds of OA machinery such as personal computers have been introduced for the rationalization of office work. In order to increase further the rate operation of information machinery and to communicate information within a business, the demand to realize a network by connecting OA machinery has increased, and various kinds of local area networks (LAN) have been developed and introduced.

Along with the diffusion of OA machinery and the development of LAN, a demand to construct LAN by connecting OA machinery of various makers (construction technology within the LAN), and demand to communicate and to process data by interconnecting LAN's will increase. In order to respond to these demands, standardization in accordance with the OSI should be pursued in consideration of the trend of international standardization.

To put it concretely, JIS standardization related to the following matters should proceed -- protocol specification and service definition of the total structure or each class of the OSI such as a fundamental reference model, protocol under an applicative level like file transmission or job transmission, items related to the control of the OSI, and local area network.

#### -2- Optoelectronics

Optoelectronics has been utilized in the various fields of measurement, processing, and medical treatment as well as communication. Under the development LASER (Light Amplification by the Stimulated Emission of Radiation) technology and optical fiber technology. Since this new technology becomes more important, its standardization is considered to be of necessity in the aspects of reliability, safety, and interchangeability. Because of this, the standardization of the JIS for various parts such as an optical fiber, optical passive part, optical composite part, and semiconductor LASER, general rules for the safety of LASER, optical measurement instruments, optical cards, and system machinery for members will be necessary.

#### -3- Home Bus System (HBS)

Relative to the concrete standardization of the HBS, from the viewpoint of expansion capability and interchangeability, it is appropriate to proceed with investigation assuming an economical system and the possibility of early realization on the basis of the present technical level, and also looking over a technological renovation and the increase of needs in the future.

The IEC/TC83/WG1 is internationally taking charge of operations related to home automation and education, and small business, laying stress on the HBS. The concept of the home bus system and the direction of its standardization are to be concluded in cooperation with each country including Japan. In doing so, it is necessary to proceed with standardization in consideration of the trend of the IEC. The standardization of the JIS for the basic specification of home bus, information consent, gate way, interface unit, and various composition machinery should be carried out.

#### -4- Media

##### a. Optical Digital Data Disk

Research and development for an optical disk in various areas such as print basis, recording materials, methods and applicational system is actively being carried out. The standardization of the JIS for a postscript-typed optical

digital data disk, erasable optical digital data disk, information recording

method, CD-ROM (Compact Disc-Read Only Memory), and the durability test methods of optical digital data disk should be prepared.

#### b. IC Card

Although an IC (Integrated Circuit) card is still used in the experimental stage, its application in various areas such as the financial world and circulation business can be expected because of an increase in its memory capacity by the order of one or two when compared to that of a magnetic card (in the case of a magnetic card, 72 characters), and the existence of the possibility of having various functions by a program given to a processor.

When standardization takes place, it is necessary not only to stand on the trend of technological development and investigation at the ISO, but also to tackle problems associated with software, data, and security by distinct utilization fields and application forms for the future. In concrete terms, the standardization of protocol among IC devices, the method to assure the security of an IC card, the information recording method, and the physical property of the IC card, should be performed.

#### c. Magnetic Recording Medium

There are various kinds of magnetic recording media, for instance, a flexible disk, magnetic hard disk, magnetic tape, and so on. These media have been widely applied to the information processing field. There is an advance in their standardization. However, due mainly to the advent of a computer, there is an increase in a demand for making small-sized and highly compact magnetic recording media. New products are presently under development.

Regarding a flexible disk, standardization for the products having dimension of less than 100-mm should proceed. It is estimated that there will be a great demand for hard disks of a fixed type with the dimension of 130-mm (5.25 inches) and 90-mm (3.5 inches) along with the diffusion and high grade of a personal computer. Therefore, in order to realize a reduction in cost by providing a generalized small-sized fixed disk and to realize an increase in the expansion of a small-sized system, standardization for the dimension of magnetic disk assembly and electrical interface should be considered.

Regarding a magnetic tape, the standardization of a cartridge tape of the size of 6.3-mm (1/4 inch) being used for the backup of a flexible tape, which is considered to be in great demand in the near future, should be studied.

In addition, for the vertical magnetizing record method being expected as technology for high density, a research study laying stress on testing procedures should be conducted.

#### -5- Multi-Media

Due to the progress in information technology, the media which record, express, and communicate various information have diversified. Unfortunately, however, there has been no identical basic technique in the process of diversification. Media have made progress independent of each other. Because

of this, generally speaking, it is difficult to utilize information transmitted from one medium to another. Recently, however, media (information) generally have digital expression. This enables the media to be technically interchanged. On the other hand, a user has been requesting information processing of a high level. These circumstances require the standardization of information interchange technology among the media such as the computer system. To put it concretely, the preparation of the standards with regard to A/D (Analog/Digital) conversion, videotex, information recording method, and media connecting method should be carried out.

#### -6- Software

Although standardization in the field of software is important for an improvement in the productivity of development and maintenance by increasing the capability of implantation, portability, and the application of software, the following items should be studied under the consideration of the feasibility and needs of standardization and cost.

a. Among programming languages (program system description languages) and middle software (such as computer graphics) not standardized, standardization should proceed according to priority. The operation of their standardization has progressed on an international scale, and the feasibility of the standardization is quite high. At the same time, their standardization may contribute greatly to implementation and utilization of a program. During the process, the addition of the function of Japanese language should be also studied.

b. Data base has been formed in various fields such as science and technology information, literature information, and economic information. But, the composition of each data base is different, and there is no interchangeability. Therefore, in order to maintain the interchangeability of data and files or to increase the handling capability of data base, standardization for a composition construction and data base management system should proceed.

c. In the field of man-machine interface, i.e., the field related to the application of a system, along with the development of OA machinery, various kinds of simple languages and integrated software have appeared. There are many themes for standardization, for instance, spread sheet, window operation, mouse operation, icon, and command system. The feasibility and effect of their standardization should be fully investigated before their actual standardization is carried out.

d. Standardization for operating system (OS), character set, and documentation should be also studied.

#### -7- Business Protocol

When an information network among enterprises and/or industries is constructed, in order to carry on information processing and receiving about dealings between enterprises and/or industries smoothly, unification of business protocol on product code, company code, the format of an account

book, and data format has become necessary. Among them, if the prospect of their standardization is already made, they should be established as the JIS, and then generalized.

In constructing a network, as a part of the popularization of the JIS, various plans should be conceived so as to realize the adoption of the JIS. It will be necessary to establish its maintenance system for the code.

#### -8- Security Counterplan

Since information processing systems have deeply penetrated society, the safety and reliability of the system is of increasing importance. The serious effect on society due to an accident or deliberate infringement can be observed both inside and outside of Japan.

According to "Computer System Safety Measure Standards" (enacted in April 1977, and revised in August 1984) by the Ministry of International Trade and Industry, the countermeasure for the system was divided broadly into two categories in the technological aspect.

The first is related to a reliability improvement function, and its countermeasure is to maintain the function being purposed even if the system has an abnormality (or at least keep the minimum function although there might be few degrees of functional degradation). The second is concerned with data protection and illegal usage prevention functions, and its countermeasure is to prevent data from leakage, destruction, and alteration, or to prevent illegal access. To effect these countermeasures smoothly, it is desirable to realize standardization for the system or individual technology.

In concrete terms, standardization for the evaluation method of the reliability of the computer system, the evaluation method of a self-examination circuit, and cryptogram technique in data communication should be studied.

#### -9- OA Machinery

OA machinery such as a personal computer and word processor has come into wide use. The exchangeability of data, the smoothness of man-machine interface, and the assurance of exchangeability among machines are considered to be important for more extensive popularization of machinery and high-level utilization. Accordingly, standardization plays an important rule. For instance, an investigation for the standardization of OA languages (including a system) and the test methods of OA machinery, the standardization of the recording methods of information stored on a flexible disk including its graphics, a machine interface for a keyboard arrangement and a VDT will be needed from both the viewpoint of human engineering such as easy working access and safety and the aspect of various protocol of an OA network such as electronic mail and server and interchangeability to assure interface among machines. It has been recently seen that a terminal connected to a host computer is utilized as a word processor or a personal computer, and reference functions and computational functions are added to a word processor (so called

a multi-functioned work station). Correspondence to these movement showing the complicated nature will be necessary in the future.

## 2. Field of New Materials

### (1) Trend of Technology

It is said that today we enter upon the new industrial revolution, and various innovative technological development is actively carried out in various fields of space, aviation, and information. In the various technological development, the development of new materials is mandatory to respond to high-level needs from the aspect of a function and performance. Social requirements for increased light-weightness, strength, and inexpensiveness in recent years has brought the development and practical application of fine ceramics, organic and composite typed new materials, and metal typed new materials. When looking at these new materials in their entirety, in all cases, some of them have been already developed, and are almost ready for practical use while the rest of them are still under research and development. The technological development of the new materials including their applicational development is expected as a key to the growth of advanced technology such as electronics, mechatronics, new energy, and aviation and space.

### (2) Necessity of Standardization

In the development and practical application of new materials since their test and evaluation methods have not been established, both makers and users cannot obtain beneficial technical information and reliable data, and stable applicational development is disturbed. Therefore, in order to make a mutual comparison of data possible, the preparation of test and evaluation methods and their standardization are necessary and indispensable. By doing the above, reliable relation between a maker and a user can be obtained, and at the same time, the confirmation of a technological level becomes easy. Furthermore, the effective development and practical application of the new materials can be expected. Since the new materials are used in the field of advanced technology development, and also applied to improve various products, their test and evaluation are different from those of conventional materials in the following respects:

[Text continues on following page]

- 1- The levels of each characteristics are different from each other by a large margin.
- 2- Applicational environment and conditions become severe.
- 3- The level of a demand for reliability is high.
- 4- Quality evaluation under field conditions is necessary.
- 5- Quality evaluation is necessary from the aspect of processing capability.
- 6- Diversity in test and evaluation.
- 7- Higher reliability for test and evaluation.

Therefore, the standardization of the test and evaluation methods for conventional materials cannot be generally applied to that for new materials without any modification. When the standardization of the test and evaluation methods for the new materials is carried out, the accumulation of their experimental data and the development of new test methods are of necessity at the same time.

### (3) Basic Direction of Standardization

Regarding kinds of standards, there are the fundamental standard, methods standard for test and evaluation, and product standard. In order to carry on the development and practical application of new materials smoothly, the basic and common fundamental standard and the method standard have priority.

#### a. Fundamental Standard

There is the JIS K6900 (plastic terminology) enacted in 1977 for the standard of terminology in the field of polymers (plastics). It is necessary to add the terms for organic and composite new materials under the consideration of conformity with the ISO in the future.

Likewise, there is the JIS G0203 (steel terminology--products and quality). However, it is necessary to unify terminology among new materials when the present situation of the development and practical application of the new materials is considered. Since both a user and a maker may select new materials by paying their attention to their own characteristics, not to the materials, there should be no discrepancy in the definition of the terminology in the three fields of organic, composite, and metal new materials. To avoid the discrepancy, the standardization of terminology is necessary before a different definition takes root in each field. For example, "delayed fracture" which is the mechanical characteristic of a structural material has the meaning of "creep" in the field of ceramics, while in the field of metals it is used when a material suddenly shows it brittle fracture due mainly to the effect of hydrogen when static tension stress is applied to it for a long time. It is feared that a difference in terminology may become a factor to prevent the smooth development and wide application of the new materials.



## b. Standards for Test and Evaluation Methods

### -1- General Rules

Since there are various kinds of materials in fine ceramics, organic composite new materials, and metallic new materials, general rules regarding common test and evaluation items for each material need to be established.

### -2- Individual Test and Evaluation Method Standards

In order to promote the development and practical application of new materials, it is necessary to make a mutual comparison of data possible by standardizing test and evaluation methods, and also to judge easily the applicational possibility and durability of the material. When doing so, in the same manner as the case of fundamental standards, it is desirable that there be the unification of test and evaluation methods in the three different fields of fine ceramics, organic composite new materials, and metallic new materials. The study of the standards of common test and evaluation methods will be necessary.

Regarding the existing standards which may become applicable to new materials with a few or partial modifications, the study of their practical application will be also effective.

## c. Product Standards

By taking users' needs into account, the trend of technological research and development, and the trend of a demand, product standards should be established in a timely manner.

### (4) Items To Be Standardized

When the standardization of the JIS is to be carried out regarding new materials, it is necessary to proceed under considerations of conformity for a standard system. Especially, making preparations for fundamental standards (such as terminology), and test and evaluation method standards should have priority.

When looking at test methods for materials which are requested by a maker and a user, and which are already in the market, the materials considered effective for the promotion of research and development of the materials and the expansion of their use should have priority.

## 3. Machinery Fields of FA, Robots, and Mechatronics

### (1) Trend of Technology

Nowadays, in the machine industry, high advancement due to the introduction of new technologies such as electronics technology, information technology, and new materials, and the remarkable transfiguration of machinery along with the

introduction of the new technologies are seen. Especially, mechatronics which combines electronics with mechanics (machine technology) has made rapid progress.

Mechatronics technology has resulted from the need for small size and light weight, precision, composition and advancement. Accordingly, there has been a movement from single function to multiple functions, and development toward intellectual capacity. Furthermore, there has been a remarkable advancement in not only hardware technology but also software technology.

It is considered that mechatronics technology will be developed furthermore under support by sensor technology, computer technology, material technology, control technology, and software technology in the future. It is expected that there might be a change from a simple operation at individual machine to systemized utilization of unified machinery by connecting each other. Therefore, standardization for the interchangeability of machinery and the mutual application of systems will be necessary. Along with high advancement in a machine system, in order to assure harmony of the man-machine system, needs for standardization has arisen from the viewpoint of the safety, reliability, and durability of machinery and systems.

## (2) Present Situation of Standardization

### -1- Present Situation of the JIS

When considering the establishment of the JIS in the field of machinery in the past, general rules of test methods for a numerical control machine tool, and test methods and inspection for a numerical control lathe were enacted around 1975. Industrial robot terminology, safety general rules of an industrial robot, a credit card for POS (Point of Sales) system, and structural safety standard for a woodworking milling machine have been ruled out. Advanced systematization by the introduction of electronics into machinery and assurance of safety have been intended.

### -2- Present State of International Standardization Activity

In the field of machinery, with respect to international standardization activity, Japan is presently participating in 54 TC's including the ISO/TC1 (screws), ISO/TC10 (drawing symbols for fluid pressure, air pressure, and vacuum apparatus), ISO/TC22 (automobiles), ISO/TC39 (machine tools), and ISO/TC184 (industrial automation system). Regarding the IEC, Japan is participating in 5 TC's including the IEC/TC69 (electric automobiles).

Japan is currently acting as a secretary for 1 TC, 5 SC's, and 15 WG's which are the TC164 (mechanical tests for a metal), TC8/SC9 (ship building and ocean structure), TC22/SC22 (automobile/motor cycles), TC114/SC11 (precision display for a watch or clock), and TC184/SC2/WG3 (industrial robots/safety).

### (3) Problems and Direction of Standardization

#### -1- FA

Due to the advancement of both the hardware and the software technologies of machinery and tools by the introduction of electronics technology and information technology, factory automation (FA) is presently progressing.

As the structural elements of FA, there is hardware such as a machining center, laser processing machine, forging and rolling machine, robot, automatic convey machine, and measurement instrument, and software for designing, production control, and maintenance control. These are combined together and then utilized as the integrated system. Presently, new products from both sides of software and hardware are developed and sold by many makers. However, their specifications are different from each other. The standardization of interface for hardware such as an optical communication conversion adaptor and mutual connection circuit connector pin, and for software such as designing and production data base, and FA communication protocol will be necessary.

In addition to the above, standardization is important not only to fundamental items which are to promote mutual understanding between the persons concerned with FA terminology, but also for the assurance of reliability in machinery and tools and systems.

#### -2- Robot

A robot has been rapidly introduced into operations such as welding, painting, assembly, and cutting and grinding. Along with advancement in intelligence, high precision, high reliability, and lightweight, the application of a robot will be expanded in various fields in the future.

At the same time, the utilization of robots in combination with other machines has progressed. As a result, the mutual connection between robots and/or between a robot and system has become a problem to be solved. The assurance of safety to get coexistence between a man and a robot in a workshop where the robot is utilized is becoming more important.

Accordingly, there is need for the standardization of a robot language, interface for a robot and peripheral equipment, performance test methods, and safety. A positive counterplan will be necessary in the future.

On the other hand, regarding the trend of the ISO, deliberation of the TC184/SC2 (production automatic system/Industrial robot) has been started since 1984. The United States and West Germany are actively addressing this issue. Japan is advanced in robot technology. Thus, Japan must address internationalization in a constructive manner.

### -3- CAD

CAD (Computer Aided Design) is composed of hardware of automatic drawing machines and software of design drawing symbols and design calculation method. CAD is unified by software and hardware.

The important thing in the application of the CAD system is interchangeability and diversity of CAD data from one CAD system to another one. Although the CAD system is presently developed by many makers, it lacks interchangeability.

Therefore, along with the diffusion of the CAD system, the standardization of CAD data base interface, which can be applicable to any kind of a system becomes more important.

Regarding man-machine interface, the standardization of software such as the standardization of correspondence between kinds of lines of drawing and displaying colors is necessary. The standardization of hardware such as mutual connectivity between a CAD machine itself and a drawing machine or a digitizer is also important.

Connection between the CAD system and the manufacturing system by the application of a computer or CAM (Computer Aided Manufacturing), and high advancement by a network system corresponding to the development of information processing technology will progress in the future. It is necessary to avoid impeding technological improvement.

### -4- Others

Besides the three fields described before, in the field of various machinery such as industrial machines, automobiles, ships, and oil pressure equipment, the introduction of electronics technology and information technology is particularly observable. Systematization, making composite products, and the increase of accuracy are recently well seen. Therefore, the standardization corresponding to technology for the above items is also needed. In the case of an optical measurement instrument, for instance, not only taking out the data of the expected format by making photoelectric conversion of optically measured data and adding the process of an electric signal, but also high-grade measurement functions under the connection with other machinery and computers have been seen. The assurance of interface becomes important.

On the other side, the introduction of new materials has progressed, and effort to increase durability and to reduce the weight of parts has been made. A preheating plug of an engine, various kinds of sensors, gears of an oil pump, machinery cutting tools, and ceramics bearing are, for instance, the result of examples in which effort has been made. In this case, the quality specifications of new materials and evaluation test methods are still problems to be solved. FA, robot, and mechatronics are the fields where dramatic progress is observed. When their standardization takes place, it is necessary to correspond flexibly to technological progress. Since technologies in multiple fields are related to each other, and there are mutually related industries, the establishment of organization where there is

cooperation among related industries including users is considered to be important. Japanese technology in these fields is ahead of other countries. Furthermore, Japan holds an important position in terms of the amount of production in some areas. Positive and prompt correspondence to international standardization is essential.

#### 4. Field of Biotechnology

##### (1) Trend of Technology

-1- Hitherto, the fermentation technology has been utilized in the production of organic chemical products and brewery products in Japan. Therefore, Japan has abundant actual results and experience in this field. Recently, on the basis of this technology, new biotechnology represented by fermentation and microorganism utilization technology as organism catalytic mechanism, the rearrangement DNA (Deoxyribonucleic Acid) utilization technology, and the cell fusion utilization technology, have been drastically developed in the various industrial fields such as chemical, medicine, agriculture, foods, electronics, energy, and resources. This technology is expected to bring a supply of new products, high value added products, and an increase in the efficiency of the production process. Progressive research and development is presently conducted in various areas.

-2- When this new biotechnology is looked at on the whole, although the cell mass-culture technology and the protein engineering related technology are still in the basic research stage, some of this technology is already in the stage of practical application. They are, for instance, in the case of the fermentation and microorganism utilization technology,  $\alpha$ -amylase has been practically developed as the starch removal agent in the textile industry, and protease has been put to practical use as a tanning agent for leather in the leather industry. In the case of the rearrangement DNA utilization technology, these are utilized for the manufacture of interferon and insulin. In addition, in the case of biosensors, a glucose sensor and a BOD (Biochemical Oxygen Demand) sensor are also already put to practical use. These technologies are expected to be commercialized in the near future.

-3- Since the new biotechnologies are characterized by products of high value added and no necessity to have a large-scaled plant as seen in the equipment industry, lead time from the discovery or invention to putting to commercial base is relatively short when compared to other industries. Thus, commercialization of these technologies could come true in a short time period.

-4- On the other hand, because biotechnology concerns life, a safety guide to environment is investigated through countries at this moment. The United States established guidelines for rearrangement DNA experiments in 1976. After this, England, France, West Germany, and Japan established guidelines. The assurance of safety at the industrial stage of biotechnology is currently studied by the OECD (Organization for European Economic Cooperation), and the results will be released this fall.

## (2) Necessity of Standardization

-1- However, as described before, biotechnology is the field where distinguished technology is evident, and there is confusion such as the difference between test and evaluation methods, or disunity of performance and indication of medicine in use, machinery and instruments, and terminology. In order to measure the activity of ferment, there are differences in test conditions such as a substrate, temperature, and time among companies--which should be standards. There is no unification in indication methods. When a comparison and investigation are made, comprehensive evaluation cannot be made. As another example, a term such as "germ removing filter" is sometimes called "sterilized filter," or "aseptic filter." In order to minimize confusion, to promote full-scale practical application in the future, and to conduct research and development effectively, needs for standardization have been increasing.

-2- Regarding standardization for technology in the stage of research and development, attention should be paid not to impede progress of technology when setting up standardization. On the other hand, standardization designed for the guidelines of basic items when research and development is just begun should be completed in the early stage, and it should be used for the promotion of research and development.

## (3) Basic Direction of Standardization

-1- A feature of the technological development of the biotechnology is such that technology itself is the object to be developed. Thus, in the field of standardization of biotechnology, in the sense of supporting technology, a focus should be mainly placed on base technology.

-2- If the fields to be standardized in biotechnology are abstracted from these points of view, standardization falls into three main groups. They are (I) medicines such as glucose isomerase and protease, (II) machinery and instruments such as a germ removing filter, and (III) others, terminology, and environment.

-3- The standardization of 17 different medicines is considered. These medicines are, glucose isomerase, protease, lipase, cellulase, (urelase), glucose oxidase, papain, (rennin),  $\beta$ -amylase, hesperidinase, buffer solution, medium, limited ferment, DNA (rigorase), terminal transposition ferment, reverse transcription ferment, and cell wall dissolution ferment.

If priority is given to standardization considering the amount of production and necessity, prompt standardization will be necessary for glucose isomerase, protease, buffer solution, and medium. In the next place, standardization should be for lipase, cellulase, (urelase), glucose oxidase, papain, and (rennin). Regarding other materials, it is considered that it may take a long time for the establishment of their standardization because of the present small amount of production and their experimental stage.

-4- Machinery and instruments which should be standardized are a germ removing filter, gas sterilized apparatus, heat sterilized apparatus, ultraviolet rays sterilized apparatus, radiation sterilized apparatus, aseptic seal, safety cabinet, clean bench, culture test tube filtering stopcock, culture container air filter stopcock, (shale), micropipet, electric floating device, DNA synthesis device, cell preservation container, filter and column for solution chromatography, precision filter membrane, dialysis membrane, reverse permeation membrane, centrifugal separator (including ultracentrifugal separator), glucose sensor, uric acid sensor, urea sensor, and lactic acid sensor. There is a total of 26 items. Besides the above, three items should be standardized as general rules. They are analysis instrument basic general rules, machinery and apparatus general rules, and biosensor general rules. Considering priorities, standardization for medical materials is most urgent. However, standardization for the following is considered to be in the next place. They are radiation sterilized apparatus, ion exchange membrane, reverse permeation membrane, uric acid sensor, urea sensor, lactic acid sensor, and general rules for biosensors. This priority is based upon the fact that machinery and instruments hold an important position for the practical application of biotechnology and the promotion of its research and development. Demand for their standardization is high.

-5- Standardization of biotechnology and environmental terminology is also necessary; there is confusion due to lack of unity at the moment. Regarding environmental terminology, the standardization of the bio-laboratory system is of necessity. Standardization of the laboratory negative pressure system and the environment monitoring system are particularly needed.

-6- In working on standardization, as seen in the general ordinary working process of the JIS, the methods to make the most of the existing data and to obtain a consensus from parties concerned can be applied to these. However, in the case of standardization of the method to measure the activity of ferment and the performance evaluation method of machinery and instruments such as a germ removing filter, sterilized apparatus, and aseptic mechanical seal, active investigation and research including some experiments are needed. Research and development work for the method to quickly measure the number of germs or bacteria in constant volume is also desired as the fundamental technology to carry out their evaluation.

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